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VOL. CXXIII., No. 2616.] TUESDAY, JULY 1, 1913. [65TH YEAR.

EDITORIAL NOTES.

The Meeting of the Société Technique.

THE members of the Société Technique du Gaz en France held their fortieth annual congress the week before last in the City of Toulouse, the capital of the department of Haute-Garonne, under the presidency of M. Auguste Boutan, the General Manager of the Lyons Gas and Electricity Company. We gave in the "JOURNAL" for June 24 a general account of the proceedings and translations of some of the technical communications. An unusual feature was the presence of a distinguished member of the English gas profession—Mr. Charles Carpenter, D.Sc.—as the reader of a paper on an important manufacturing subject; and we regret that, owing to the clashing of the meeting with that of the Institution of Gas Engineers, we were unable last week to give more than an abstract of his contribution to the transactions of the French Society. The full text of it, however, with illustrations, appears elsewhere to-day. In addition to the papers, there were discussions on several subjects; and the members were afforded an opportunity of listening to M. Sabatier, the holder of this year's Nobel Prize for Chemistry, who discoursed on "Catalysis." Reports were presented by the various Commissions of the Society—that of the Distribution Commission being of special interest. The members were accorded a hearty welcome to Toulouse, where they were entertained in the most liberal manner by the Directors of the Gas Company, whose Manager (M. Versepuy) made excellent arrangements for their enjoyment of what must have been a charming open-air *fête*. The members had their usual subscription banquet; and after the business of the meeting was over, they had an excursion to the Pyrenees. Altogether the meeting in the city on the banks of the Garonne will, though the temperature was at times rather exhausting, evoke pleasant recollections among those who took part in it.

The general sketch of the proceedings published last week is interesting from the indication that it gives that matters in connection with the gas industry in France are much in like case as gas affairs in this country. Our nearest Continental friends have their legislative and commercial troubles and problems just as we have in this country; and they are exercised precisely as we are to resist all things that are adverse to industrial progress, and to cultivate those that tend to greater expansion. Though, for example, we are heartily in favour of the certification and stamping of meters under statutorily authorized conditions, providing that the conditions coincide with modern requirements, it is rather late in the day to change, as is proposed in the case of French gas undertakings, from the local authority testings which have hitherto been found sufficient. There is the trouble, too, concerning the tax on light, which is about as retrograde a movement as would be a tax on cleanliness or other sanitary condition. The reports of the various Commissions and the papers submitted by individual members treated of a variety of manufacturing, distribution, and commercial topics—in fact, there is not a department of the service in which a keenness is not being displayed by our French colleagues that augurs well for the future. The communications on this occasion ranged from matters of high scientific import down to improvement of details. In the manufacturing department, a great deal of attention is again being devoted to furnace work for the heating of settings both retort and coke-oven for the carbonization of coal. The outside producer claimed consideration at the meeting. But we think we ought to at once make the point—well known in this country—that the outside producer for the heating of retort-settings is quite an ancient institution in Great Britain, and notably at the Glasgow and South Metropolitan Gas-Works. But our French colleagues have had their thoughts turned to what is being done with the types of recovery gas-producers at various Continental works; and in this direction, again, simultaneous work, in connection with coke-ovens, has been proceeding here. The point was, however, made at the meeting of the Société Technique, that the use of such producers enables a clean gas to be supplied to the settings, and that this has the advantage of prolonging the lives of the latter. There is something in this point; and, after Mr. Chaney's paper at our own Institution meeting, and the attention that it invites to the potentialities of the modern outside producer, supplemented by the probability of experience showing reduced wear and tear on the fabric of settings for the carbonization of coal, a closer study will be made of this line of manufacturing development.

The papers covered other details of gas production; and kindred to this class of communication was the favourable consideration given by one to the utilization for town supply of part of the gas produced by coke-ovens, and the examination made in another of the composition of tar oils and their utilization. Among the reports and papers, subject-matter is found relating to distribution. In one report, it is seen that inquiry has been made in connection with high-pressure distribution and utilization. In this connection, one or two points were advanced which are rather striking, in view of experiences in this and other countries. Among other things, there has been an attempt to determine the limit of pressure to which gas can be submitted in relation to the tightness of joints and illuminating power; and 78 inches of water is spoken of as a limit. Little heed need be paid to the question of illuminating power within any likely pressure limits to which it may be desired to work; but really we cannot understand why any such figure as the one mentioned has been fixed upon. It presents itself to us as being of an arbitrary character. The tightness of joint depends upon the nature of the joint used. There are special joints in use in this country for high-pressures that are, at the works of the makers, tested up to 1000 lbs. pressure; distribution at several pounds pressure is proceeding in high-pressure mains in England; pressures up to 80 lbs. for transmission purposes are employed in America; and for ordinary high-pressure lighting in this country, 80 inches pressure is common. Our French colleagues will have to seriously reconsider (and more fully) the limit of 78 inches. There is no occasion to stop here, providing suitable joints are in use, if requirements will be better satisfied at a higher pressure. There is a further point. The Distribution Commission, while they see some advantage in long steel mains for high-pressure work, incline to the recommendation of cast-iron pipes, owing to the quick oxidation of the former. The reason does not seem adequate; for rapid corrosion of steel pipes can be prevented by the application of suitable preservatives.

The members of the Société Technique are also searching zealously for new applications of gas; but there was not anything particularly new brought forward on this occasion. The most promising application, if bakers and confectioners can be induced to quit the rut of conventionalism, is the application of gas to their ovens in the place of solid fuel. Paris is working well in this matter; for as bread must be had whatever the general conditions of trade, and as the bakeries are numerically great, a good field of business is seen in this direction. The paper presented by M. Rouland gives many structural details as to ovens and needs, as well as hints from the Paris experience. The time will no doubt arrive when bakers' ovens specially designed for gaseous heating will be the vogue. Meantime, the subject has to be tackled from the standpoint of existing ovens, and their rapid conversion (even interchangeability) from one form of fuel to the other. The special burners that have been devised in Paris with this in view will be suggestive to those who engage in this country in the work of trying to turn the bakers from their old practices to the conveniences and time and other economies of the new mode. We shall

watch with interest for any developments arising from M. Grebel's paper on the use of compressed coal gas for driving motors. Experiences in this country have revealed the limitations of traction by the use of gas-driven motors; and disclosure is incidentally made in the contribution of our studious friend of the little hope that exists for more than a restricted (if any) application to modern motor cars.

Success of Hot Purification.

WHILE there is a little feeling on our part that Mr. Charles Carpenter, D.Sc., deserves to be chided for making the platform provided by our friends of the Société Technique du Gaz (instead of a home platform) the one from which to publish the first technical information regarding the process developed at the works of the South Metropolitan Gas Company for the decomposition of carbon bisulphide in gas by catalytic action, and its conversion into sulphuretted hydrogen, it must be recognized that there was a certain fitness about both the presence of Mr. Carpenter at the Toulouse meeting, and the subject-matter of his communication. M. Robert Ellissen was present in London at the Jubilee Meeting of the Institution of Gas Engineers as the delegate of the Société; and it was the respected father of M. Ellissen (M. Albert Ellissen) who, in the first year's existence of the old British Association of Gas Managers, was collaborating with Mr. T. G. Barlow (the first Editor of the "JOURNAL"), both in Paris and in London, in the investigation of the subject of sulphur purification, and who was present at the inaugural dinner of the old Association. An interval of just about fifty years divides that inquiry from the appearance at Toulouse of Mr. Carpenter with his paper, announcing the development of a system which has carried sulphur purification to a high point of refinement—giving a finished gas with an average sulphur content of only 17·8 grammes per 100 cubic metres (3530 cubic feet), or equal to rather less than 8 grains per 100 cubic feet. The reduction of sulphur is equal to 80·7 per cent.; and this is effected at a cost, not including the removal of the sulphuretted hydrogen, of something like 0·35d. per 1000 cubic feet, for fuel, manual labour, interest, depreciation, and repairs all included.

Such figures, in these days when it is essential that gas shall be distributed of the utmost purity in order that progress shall not be hindered by any deficiency in quality, are sufficient to cause something more than passing interest in the work the South Metropolitan Gas Company have been quietly doing, and to produce genuine compliments upon the character of its success. The tale of the disappointment there has been, the difficulties encountered, and the dogged determination to achieve success, can be readily constructed from the plain statement of facts presented by the paper read before the Société Technique. But these are matters of the past. The important thing is success has been achieved—not only on the laboratory scale, but on two working-scale plants, one of which represents a daily treatment of gas of about 10 million cubic feet. A large measure of the honour for success Mr. Carpenter awards to Mr. E. V. Evans, the Company's Chief Chemist, though the encouragement, personal interest and work, and the boldness born of confidence of the Chairman of the Company have played an incalculable part in the development and the success. The task attempted was not one that would have succeeded in the hands of anyone who allowed difficulties to promote discouragement, or who was not bold enough to go forward into working-scale trial when ultimately successful laboratory work had carried conviction that the reward was within reach. The workers of the South Metropolitan Company do not by any means claim that they were the first in the field in proposing to effect the purification of gas from sulphur compounds by heat, nor even with the idea of using a metallic salt for producing the decomposition of carbon bisulphide, and its conversion into sulphuretted hydrogen. But they do claim, and they have a right to claim, that they are the first to bridge, by experiment and discovery, the wide gulf between former knowledge and practical working on lines producing a large efficiency, at little trouble and expense per 1000 cubic feet of gas. Of his paper, Mr. Carpenter devotes more than one-half, and that the first half, to a history of prior work; and thereby awards credit for work done and suggestions of predecessors in the same line.

The low efficiency, trouble, and expense that were the results of previous efforts in the use of the heating process for the decomposition of carbon bisulphide were likewise the first experiences at the South Metropolitan Gas-Works. But what was done satisfied that what was needed was a catalyzer that required the lowest temperature for the reaction, compatible with a rate of gas passing on which it would be practicable to work, as well as discovery of the form in which the catalyzer would be best exposed to the action of the gases. The result was that it was found that these conditions were fulfilled by the use of 1 inch diameter balls impregnated with reduced nickel, obtained by the reduction of the chloride in a current of hydrogen. This was an important finding; but the preheating of the gas before contact with the catalyzer was also an invaluable—perhaps the most valuable—advance towards success. As to this, Mr. Carpenter says: "The most important advance "was made in discarding the attempt to obtain the tempera- "ture of the reaction by application of the heat to the out- "side of the retort containing the catalyzer, and substituting "an arrangement, suggested by Mr. Evans, in which the gas "was previously heated up to 100° C. below the temperature of "reaction before coming in contact with the catalyzer. This "allows of keeping the retort at the practicable tempera- "ture of 500° C." From the success so achieved, the Company's workers have passed to large-scale working—first to plant equal to 1½ million cubic feet of gas per day, and then to plant equal to 10 million cubic feet, improvements and still higher efficiency accruing with experience, until we have the working results mentioned in the first paragraph of this article, and in more detailed form in the translation from the French version of Mr. Carpenter's paper that appears elsewhere in this issue. These good results notwithstanding, Mr. Carpenter frankly confesses that there is still room for improvement in the plant. The losses of heat in the existing plants are at present considerable, and the installation costs are heavy. But the workers see their way to removing these defects; and it is a sufficient testimony of faith and satisfaction to say that plans have been prepared for the application of the system to the extensive East Greenwich production.

There are one or two other interesting points. The existing large working-scale plants have been in operation now for some time; and the catalyzer is as active as ever—there does not appear to have been any deterioration in any way in its effectiveness. A sluggishness in activity is produced by a deposit of carbon on the catalyzer; and, at intervals of thirty days, it is necessary, by combustion of the deposited carbon, to restore full activity. In an address by Mr. James M'Leod to the Scottish Junior Gas Association (Western Division) in November last, there were some suggestive points referring to the expense and wastage of the nickel salts, and regarding the formation of nickel carbonyl. The results presented by Mr. Carpenter answer the first question; and as to the nickel carbonyl, frequent tests have been made to discover it, but, by the precautions taken in regard to temperature, there is no trouble in this respect. As to the quality of the gas, other than in respect of purity, an analysis, before and after treatment, shows that nothing in the way of depreciation occurs.

In this paper, presented to members of the gas profession in a city in Southern France, Mr. Carpenter has given first complete information regarding the technical working of a purification process that promises to raise the standard of the purity of gas, and not only so, but to show the means by which it is to be accomplished at comparatively low cost per 1000 cubic feet.

Carbon Bisulphide and Alkalinated Cellulose.

WE must defer until next week editorial comment on the proceedings at the annual meeting of the German Association, a review of which, with translations of certain of the communications, appears in other columns to-day. But, in view of reference in the foregoing article to the work that is being done by the South Metropolitan Gas Company in the removal of carbon bisulphide from gas by conversion to sulphuretted hydrogen, and then the purification of the gas from this in the ordinary way, it may be pointed out that the German meeting raises the question whether there are not other methods by which the same result can be achieved, in a simple and inexpensive manner. It will be remembered that, at the meeting of the Institution of Gas Engineers, Dr. Rudolf Lessing alluded to the use of alkalinated cellulose for the removal of carbon bisulphide; and now, in a paper read before the German Association, Herr F. Kuckuk, of Heidelberg, described the actual operation of the process at his works. In it there appears to be promise, though more

information is still desired before any definite conclusion can be arrived at. The compound of alkali and cellulose that is used is known as "Athion." It will be observed how strikingly similar are the results given in Herr Kuckuk's communication to those contained in Mr. Carpenter's paper. In the working at Heidelberg from a gas containing an average of 30·75 grains of carbon bisulphide per 100 cubic feet, some 75 per cent. of the impurity is regularly extracted, so that only 7·87 grains are left in the purified gas. This is excellent; but reliable figures are needed as to the cost of working per 1000 cubic feet. An analysis, with illuminating and calorific power tests, of gas treated and untreated by the alkalinated cellulose would be of service; and, as soon as the experiments are finished which are to determine whether there is a field for the utilization of the fouled cellulose, we shall be pleased to hear further from Herr Kuckuk, whom we compliment on the results he is so far able to publish.

Hope for an Important Calorific Power Movement.

The time has come when there need not be further talk as to the uselessness of the illuminating power standard, in view of the fact that all but a small percentage of gas is consumed for its heating quality. The inconsistency between the ruling standard of quality and the applications of gas is generally agreed; but the steps taken to bring about a correlation between the two have been wonderfully spasmodic and leisurely considering the large professional acceptance of the opinion that a change is now not only desirable, but essential to the work and maximum progress of the industry. It seems that the industry requires a very definite lead; and, unless we are much mistaken, it will now shortly be given. Those who paid close heed to the utterances of Sir Corbet Woodall, in his presidential capacity at the recent Jubilee meeting of the Institution, will have regarded as significant the expression—both in his address and in his speech at the Jubilee Dinner—of hope that the next session of Parliament will see an important move in the change from the illuminating power standard to a calorific power one. We have not asked Sir Corbet whether this means only a personal hope that something will be done, or whether, in the background of general information, initial action has already been taken towards an "important movement." But we know him well enough to say that it would have been an exception to his habit to make publicly, within two days, pronounced references to a subject of this kind if there was not something already on the wing. Yet we have hesitated to approach him on the matter, because of the feeling that, if some positive movement is being made, and the time had been ripe for further disclosure, he would not have left the matter where he did in both his Institution address and in the after-dinner speech.

If, however, guess be made to what is likely to happen, we should not go further than a consideration of the conditions now existing in the Metropolis, and suggest the probability of a rearrangement of standard and testings there. The first three years of the working of the Gaslight and Coke Company under a dual standard of illuminating power and calorific value have passed; and it will be remembered that the terms of the calorific power standard gave the right to ask for a revision at the end of the three years. We know that at times it has been somewhat irksome and wasteful for the Company to comply with the two standards; and they certainly have increased the anxieties of the officials. Before and during the time that the penalty calorific power test has been in force with the Gaslight and Coke Company, there have also been, at the London County Council testing-stations, official testings, for information only, of the calorific power of the gas of the South Metropolitan and Commercial Companies. Therefore, in the case of these Companies, the illuminating power test is the only one to which a penalty for deficiences is applied. The unfairness—to say nothing of the absolute absurdity of the position—imposed on the Gaslight Company, of having to work to two standards of quality, while no other concern in the Metropolis, or in the whole kingdom, was so handicapped, is obvious. But we can thoroughly understand that the London County Council would be somewhat reluctant to drop the old illuminating power standard while the other two Companies were working under it. However this may be, excepting when the London County Council took advantage of the appearance of the Gaslight Company in Parliament to impose, as a condition of settlement of opposition, the calorific power test in addition to the illuminating power one, they have for years past shown a disposition to maintain uniform standards and conditions of testing in the Metropolitan area.

Therefore, one can hardly imagine that the Council would be willing to turn over completely to a calorific standard in the case of the Gaslight and Coke Company without a simultaneous conversion of standard and test in the cases of the South Metropolitan and Commercial Companies. That the London County Council are not now opposed to the change of standard from illuminating power to calorific value is testified by their action in the cases of the conversion from one test to the other in the Bills of the Wandsworth and South Suburban Companies during their progress through Parliament in the session of 1912. As a matter of fact, they were not only willing parties to, but did a good part in facilitating, the dropping of the illuminating power test, and the setting-up of the calorific power one. The Metropolitan Gas Referees, too, although they have no voice in any decision as to the standard of quality imposed upon the Metropolitan Companies, but have only to prescribe conditions and carry out the decrees of the statutes applying to quality, are influential. Therefore the remark at the Jubilee Dinner of Professor C. V. Boys, who is one of the Referees, that "the only sensible and absolute test of the value of gas is "the calorific power one," will carry considerable weight in the consideration of this question. However, we have not the slightest knowledge whether the Metropolis is the only direction in which an "important movement" may be looked for. But it would not (considering existing conditions) be a surprise to find our surmise correct. Still it would clearly be unfair to press Sir Corbet on the point. If, however, he desires at the moment to make any further communication, in view of this article, to explain how much weight is to be placed on the words in both his Presidential Address and at the Jubilee Dinner—whether they express a mere hope, or something more definite—the gas industry would be particularly interested. If he refrains, it must be taken that the time is inopportune.

Something has to be done. At the rate at which the change from an irrational standard to a rational one is proceeding, the day is remote when calorific power will be the common standard of the quality of town gas. There are two or three points that it is desirable to make while upon this question. Professor Boys, in his remarks at the Jubilee Dinner, urged, with considerable force, and he is backed by a large amount of technical opinion, that only a gross calorific power standard should be applied to town gas, and not a net one. He does not say this without knowing, from long experiment and experience, of what he is talking. This is a point that is worth noting as coming from an authoritative source; besides which the gross test is part of the latest standards agreed to by Parliament and the London County Council. If an "important movement" does come along next session, there may be full assurance that there will be careful consideration of the conditions. There is no desire to see quantities standardized, but conditions must be. The terms of the South Suburban clause are the clearest "all-British" ones that we have had statutorily introduced; and they serve well as a model. In the case of the Bills of the Morley Corporation and the Porthcawl Gas Companies this session—the first two gas-supply authorities to voluntarily set afoot Bills with a calorific power clause in them—the South Suburban clause was adopted in every particular; and had the York Corporation Bill not been vetoed by the ratepayers at the very beginning of its short-lived career, it would also have gone forward containing the same clause.

In this connection, there is one point which it is opportune to make. It is that we do not want any unnecessary embroidery attached to a statutory calorific clause. Some of the workers in the gas industry are occasionally making suggestions which it would be just as well should not be made at the present juncture. For example, without any intention of doing harm, Mr. E. W. Smith, at the Institution meeting, suggested, in his reply to the discussion on the paper written by himself and Mr. Walter, that attached to a standard of calorific power should be a standard of flame temperature. The gas industry does not want a complicated statutory standard of quality. All that it requires—all that is, in fact, necessary—is a plain calorific standard to which to work. The standardization of the conditions of gas testing—the magnitude of the figures being a distinct, and legitimately discussable, point for each undertaking under its own conditions of working—is the important thing; standards of flame temperature can be voluntarily applied in practice. Some of our friends have had little experience

of parliamentary warfare, and of the amount of diplomacy that is requisite in connection with it. There are, for example, among them those who, appearing to overlook that gas undertakings, for economic reasons, have to use the nearest available coals, and sometimes a variety of coals, have named B.Th.U. figures, as being best for all purposes for consumers, that are higher than circumstances in different parts of the country would economically allow. If these students of the subject of calorific power under their own local conditions would refrain from giving expression to views that, unless they qualify them, may be harmful, by being used against gas undertakings by an opposition desirous of obtaining a higher calorific power than is economically expedient, they will be doing a service to the gas industry. This suggestion is made in all friendliness, because we know that there is no intention to impress views that might be injurious to gas undertakings in any part of the country. What has been occasionally said has been with an inappreciation of the difficulties that have to be encountered in the Parliamentary Committee rooms from opposition experts and agents who are ever on the alert for material with which to back-up their cases for obtaining for their clients something more than the promoting gas undertakings can be reasonably expected to give.

Lighting of Industrial Establishments.

THERE is an educational use in the reports of the Chief Inspector of Factories and Workshops (Sir Arthur Whitelegge, M.D.), and of the District Inspectors, to those who are capable of discrimination between the material which represents actual facts and well-based opinion and that which one occasionally finds in certain of the statements of the latter which is entitled to an opposite descriptive character. The report that has just been issued is, in its main parts, valuable; and no one connected with the supply or use of light, heat, and power ought to miss the profit that can be obtained by a perusal of the parts of the report that bear upon his operations. The subjects are many; and they are reviewed elsewhere in this issue. There is only one to which here it is desired to direct special attention. The results of the investigation into the lighting of factories by Mr. D. R. Wilson, which formed such a valuable section of last year's report, have had, it is patent from the indications contained in the present one, a good effect upon the District Inspectors. They are advising factory owners to take steps to improve the lighting of their factories, and especially to protect, by means of suitable globes and shades, the eyes of workers from glare—particularly where high intrinsic brilliancy metallic filament electric lamps are used. There are also signs that factory owners themselves are, though slowly, becoming more alive to the economic value of good lighting. At the same time, those gas managers who never offer advice without it is asked for, and rarely think of endeavouring to make an investigation of the current methods of lighting used by some of the best customers of their undertakings, would be wise to note that the opinion among the inspectors is that there appears to be a lack of knowledge on the part of factory owners as to the general principles on which lighting should be carried out. This is a distinct reflection, and certainly not an unwarranted one in some places, upon the suppliers of the agents whereby light is obtained.

The instructive investigation that Mr. Wilson has instituted, during the past year, concerning the artificial illumination of iron foundries further confirms the prevalence of the lack of knowledge. He gives tables showing the character of the lighting he met with in foundries which could be classified as well illuminated; but even in regard to these, whether the means of lighting be by high-pressure gas, cluster burner incandescent gas-lamps, or electric lamps, the remarks in the report indicate that few examples of the lighting are free from imperfections. In those foundries that were found to be badly lighted, we see an appalling existence of flat-flame burners as well as upright incandescent burners unprotected from dust. This ought not to be; but who is to guide the foundry owner to a more economical and efficient system of lighting, if not the gas manager or his staff? The conditions existing in a foundry are altogether opposed to the attainment, without the application of special means, of the highest lighting efficiencies. The dark moulding material and wall surfaces, the dust, steam, and smoke, the heavy structural work, and the equipment deny to the means of lighting any aid external to themselves. There ought to be nothing in such places but protected high efficiency burners. Large units are necessary, but not so large that deep shadows cannot be prevented. A useful unit is the 1000-candle high-pressure lamp. A downward light is required; therefore the inverted incandescent type of gas-lamp is the best. A dust-proof lamp is required; there are the dust and insect proof lamps such as are sent to tropical climes. There is no occasion to have anywhere in a foundry to-day an illumination, at a foot above floor-level, of less than 0·33 foot-candle, which is the lowest point at which Mr. Wilson allows the applicability of the expression "adequate illumination." In most foundries this illumination could be obtained by a proper utilization of the quantity of gas—perhaps less—now consumed in flat-flame burners, which cannot be said to adequately illuminate. There is work to be done in industrial illumination; and the degree of success of competitors will bear some relation to the laxity of the gas manager and his commercial staff in showing the factory and foundry owner how gas can economically produce improvement in his lighting arrangements.

Bye-Product Recovery Producer Plant.

A reminder of the case that Mr. W. Chaney, of Birmingham, put forward in his paper before the Institution of Gas Engineers, for the heating of largeunits of coke-ovens or retort-settings by outside Mond bye-product plants, and the economy to be so derived, is given by a statement made by Mr. Harold Gray, of Accrington, during the discussion of a paper by Mr. S. Z. de Ferranti, on "Prime Movers for Electric Power," at the recent meeting of the Incorporated Municipal Electrical Association. Naturally the electricity industry, like the gas industry, are alive to the importance of bringing down to as fine a point as possible net generating costs. At the Accrington electricity works, there are two 1000-horse power gas-engine units; and the gas-producers are of the ammonia recovery type. Since last winter one or other of these plants has been running steadily for 164 hours a week, at as near full load as possible; but it has not done anything near the 100 per cent., due to the fact that there is very little load on Sundays. Nevertheless, an average of approximately 86,000 units on one set is being turned out per week. The fuel (Lancashire steam slack) used per unit generated in the last three months—this is low—has been 1·56 lbs., which is equal in cost to 0·125d. The bye-product plant has only been working a month or two; and this credits the generating plant with 0·07d. per unit, which is more than half the total fuel cost. This does not tell the whole tale; but it directs attention to another economy, through the recovery of ammonia from the fuel used, in electricity generation. There is, of course, the point as to a stand-by producer; but Mr. Gray estimates that the cost of keeping a 1250-horse power producer ready for work within a quarter of an hour would for a week be slightly over ½ ton of coal, which compares favourably with steam plant. The gas-engines can be run up within twenty seconds, and be synchronized within a minute.

Hygienic and Heating Efficiencies of Gas-Fires.

Of this we are confident, that the controversy that has been proceeding in our columns on this subject is going to result in much good to the gas industry. It has given a fillip to investigation on the part of gas-fire makers of the question as to whether a perfect hygienic efficiency can be produced in a gas-fire *per se*—that is to say, free from the aid of flue-pipes—without, when the fire is fitted to a chimney or flue, depreciating the radiant heating efficiency of the fire. If the makers, save Messrs. John Wright and Co., agree that this can be done, we can see them working together to that end, and probably the Birmingham firm named will eventually come into line, as they must do if many customers insist on fires complying with a more rigorous standard of hygienic efficiency than has been hitherto applied. What those responsible for the gas-supply business require is the gas-fire that will give the highest possible radiant efficiency with an indisputable hygienic efficiency under all reasonable circumstances, which reasonable circumstances do not always permit of the length of flue-pipe necessary to overcome the travel of products of combustion from beneath the canopies of some gas-fires.

Some Further Tests.

In this week's issue of the "JOURNAL," there is an extremely interesting article by Mr. Thomas Glover (of Messrs. Glover and Main), who has been making independent tests with two fires—a

Wright and a Davis fire—under conditions and methods of testing that are fully and freely explained. Of what these conditions and methods consist can be ascertained by reference to the article; but incidentally it is clear that Mr. Glover is not highly enamoured of the "Shadowgraph" test. That, however, is a relatively unimportant point, as it does not matter the nature of the system of testing so long as reliable indications or results are obtained. The matter that is of immediate importance is that the contention of the Davis Company is upheld by Mr. Glover's tests, that complete hygienic efficiency can be obtained without a length of flue-pipe attached, and that without any deterioration of radiant heat occurring when the fire is subjected to chimney draught. With the two fires tested, under the described conditions, the curves show that the whole of the carbon dioxide was passing into the flue in the case of the Davis fire when fitted with only 13 inches of flue-pipe; while in the case of the Wright fire (according to the curves) nearly 57 inches of flue sections had been attached before a break came in the rise of the curve, indicating that, until this length of flue had been reached, the whole of the carbon dioxide was not passing (under the conditions of testing) into the flue. This suggests to Mr. Glover that prior to this point being reached, there was a bye-passing under the canopy. In the cases of both fires, the radiant efficiency was practically unaffected by the added flue lengths up to 80 inches; and Mr. Glover therefore assumes that it was from the convected heat that the increased flue temperature was drawn in the case of the Wright fire. All through the tests, though the radiant efficiency was not disturbed in either case, that of the Wright fire was somewhat higher than that of the Davis fire; but to set against this are the carbon dioxide findings.

Gasholders as Guides for Aërial Navigators.

A new use is suggested for gasholders, beyond the ordinary ones for storing gas and serving as excellent guides for a stranger in a town to ascertain the centre of the local supply of light, heat, and power. The suggestion comes from France. The French Aërial League, as well as the Société Technique du Gaz, have been considering the matter; and particulars as to the proposal are obtained from a paper presented at the recent meeting of the latter body. What is required is a means of guiding those in command of aërial craft; and, as there are no practical means of aërially suspending sign-posts, there must be in this regard reliance on mundane aid. A gasholder being a dependable landmark, and providing on its crown a good platform from which to denote longitudinal and latitudinal position, it is suggested that use be made of it so that the pilot aloft may, by the aid of his chart, and the gasholder indications, direct his course accordingly. Briefly, the plan is that on the charts marking might be done from any point by means of the geographical co-ordinates, longitude and latitude. In order to distinguish longitudes east or west of the meridian, the longitudes towards the east would have to be underlined horizontally. The corresponding designation would be painted on the gasholder crowns in figures some 6 ft. 6 in. long, and in white on a black ground, or *vice versâ*. M. Laurain appears to have overlooked one thing in his proposal, and that is how it could be applied in the case of spirally-guided holders, which have become so popular in this country. There could never be any reliance on the horizontal line. One of the claims put forward by the French Aërial League for the consideration of the question is its usefulness for reconnoitring in time of war, and its assistance in avoiding trouble in times of peace. The latter is all right; but the facility for reconnoitring in time of war would be as useful to the enemy as—perhaps more so that—as to the home army.

Manchester Gas Affairs.

In last week's issue of the "JOURNAL" (p. 1023-4) there were reproduced the principal portions of the report of the Manchester Corporation Gas Committee for the financial year to March 31. The keynote is one of—it may fairly be said—remarkable prosperity. In the first place, there is recorded an increase in the output of 4½ per cent.; and at the same time an equally satisfactory feature is the growth of about 1500 in the total number of consumers. The "broadening of the basis of business" is always welcome. The gross profit is the highest on record, at £231,000; while the consumers can congratulate themselves on the fact that the average price of gas (just over 2s. 2¼d. per 1000 cubic feet) is the lowest recorded. Of course, the high prices obtained for residuals have had a very great deal to do with the excellent financial results of the past year. No doubt, the reduction in prices, combined with the introduction of a sliding-scale of charges according to the quantity of gas consumed per quarter, and the adoption of the "discount for early-payment" system, which has just come into force, will have a considerable effect on the finances; but it is hoped that these concessions will serve as a stimulus to the consumption of gas—thus benefiting the department, as well as, by the reduction of smoke, the citizens at large. Interviewed by the representative of a local paper, the Chairman of the Gas Committee expressed the view that the Manchester gas undertaking has not reached the zenith of its prosperity. In this we believe he is correct, and look only for the passing of time to justify the faith that is in him. Note may be made of a generous acknowledgment by Mr. Kay, in the statement that it is clear that the public knowledge about the value of gas is increasing, thanks no doubt in great measure to the work of the British Commercial Gas Association. He pointed out with pardonable pride (and the fact is one on which Manchester may be congratulated) that his Committee helped to start this new organization, and that the city gave it a good "send-off" when the Association held their first annual conference in the Town Hall at Manchester. All who were present at that gathering, or who read the full report of the proceedings that was published at the time in the columns of the "JOURNAL," will agree that it was indeed a good send-off.

Further Details.

Along with the report, we received a print brought up to date of the statistics relating to the Corporation gas-works which were issued last year, by the Superintendent of the Department (Mr. F. A. Price). From these it is gathered that, for the year ended March 31, the net profit per 1000 cubic feet of gas sold was 8·08d.; and of this, 2·12d. was paid to the city fund, and 2·98d. was placed to sinking fund. The net cost of the gas in the holders was 7·04d. per 1000 cubic feet sold, and the net cost delivered 1s. 4·49d. As the price at which it was sold averaged 2s. 2·31d., there was a gross profit of 9·82d. per 1000 cubic feet of which interest on loans absorbed 1·74d. The income from residual products—coke, tar, ammoniacal liquor, and sulphate—in 1893 was equal to 32·93 per cent. on the cost of the coal and cannel carbonized; whereas for 1913 it was 90·35 per cent., which compares with 71·91 per cent. in the preceding year. In the period from 1893 down to the end of the past financial year, no less a sum than £1,062,003 out of profits has been applied in relief of the city rates; while the total amount applied in lieu, or in aid, of city rates since 1844 (the first year after the undertaking was acquired) is £3,115,084. The producing power of the different stations per 24 hours is 31 million cubic feet; and the largest consumption in this period during the past year was a little over 28¾ millions. The total quantity of gas produced in the twelve months under review was about 5945 million cubic feet, or equal to 11,903 cubic feet per ton of coal carbonized. The production of carburetted water gas was in the proportion of 19·44 per cent. to the total output; the net cost of this gas (16-candle power) in the holder being 8·64d. per 1000 cubic feet. Hire is not charged for either meters or cookers; and gas-fires are supplied and fixed either on simple hire or on hire-purchase. Of the total quantity of gas transmitted from the works, 3·24 per cent. was unaccounted for. The gas sold per ton of coal carbonized was 11,331 cubic feet; and the percentage of consumption was 94·52 within the city, and 5·48 without.

Points from Bradford.

As is the case with Manchester, the figures for the past year's working at Bradford are excellent. An increase of over 3 per cent. in the quantity of gas sold, is accompanied by a substantially larger net profit, at £19,745. This is £10,127 better than last year, and £6811 more than in the previous best year since the price of gas was lowered to its present figure. Just at this time, when the question of coal is occupying a more than usual amount of the attention of those connected with the gas industry, the figures contained in a table compiled by Mr. C. Wood, the Gas Engineer, showing the average prices paid for coal used during the past twenty years, will prove interesting. Over this period, on only three occasions has the actual cost of coal used, including all

handling, been higher than the latest figure quoted; and an explanation of the price paid on one of these occasions is furnished in a footnote to the table. Whereas the total quantity of gas produced last year was just over 2½ per cent. more than in the preceding twelve months, the amount sold, as already stated, exceeded 3 per cent. more than the figure for 1911-12. This indicates a gratifying decrease of ½ per cent. in the unaccounted-for gas. Though wages have gone up, it is pointed out in the report that, by the introduction of labour-saving machinery on the installation of vertical retorts at the Thornton Road works, the carbonizing wages have been substantially reduced, and at the same time the work has been rendered much lighter for the men employed.

PERSONAL.

Dr. Auer von Welsbach has just been elected a member of the Berlin Academy of Sciences.

Mr. H. H. Gray, formerly Lecturer and Assistant to Dr. Bone at Leeds and London, is now engaged with Mr. E. W. Smith as Assistant at the Central Laboratory of the Birmingham Corporation Gas Department.

The successor to the late Mr. John Maclaren, of Duns, in the management of the gas-works is Mr. Frank Welsh, who is at present acting as Assistant Gas Manager to the Grangemouth Corporation. He was originally trained in Galashiels, of which place he is a native.

Mr. J. A. Brentnall, Gas Engineer and Manager of the Abercarn (Mon.) Urban District Council, has been appointed Manager of the Northwich Gas Company, in succession to Mr. S. S. Mellor. There were 66 applicants for the position, in response to the invitation which appeared in the "Journal" a few weeks ago.

Mr. John Urquhart, Chief Assistant to Mr. R. W. Edwards, the General Manager and Secretary of the Aldershot Gas, Water, and District Lighting Company, has been appointed Engineer and Manager of the Dorking Gas Company, in succession to Mr. S. Carpenter. Mr. Urquhart was educated at George Watson's College and the Heriot-Watt College, Edinburgh, and received his early training at the works of Messrs. James Milne and Son, Limited, Edinburgh, under Mr. Henry O'Connor. He left Edinburgh in 1902, to take up the appointment of Works Assistant at Aldershot, and a few years ago was promoted to the position he is now relinquishing. During the time he has been at Aldershot, there have been considerable developments of the Company; the annual make of gas having increased from less than 200 million to 350 million cubic feet—necessitating the complete remodelling of the works. This enabled him to gain a unique experience of a thoroughly progressive concern.

OBITUARY.

We regret to record the death, last Wednesday morning, of Mr. Joseph Braithwaite, Engineer and Manager of the Wrexham Gas Company. Deceased, who was sixty-seven years of age, had been in failing health for some time. Before entering the service of the Company nearly twenty years ago, he had had varied experience in connection with gas and water undertakings in Lancashire and the North of England, as well as abroad in Nova Scotia. At Wrexham, he succeeded Mr. Hesketh as Assistant Manager to Mr. Walker on the former's death in 1897; and early the following year, on Mr. Walker's retirement, he was appointed Manager. During his period of service he carried out many improvements at the gas-works. He possessed the entire confidence of the Directors, who always lent a sympathetic ear to, and actively co-operated in, his various projects. He took a keen interest in the education of his subordinates—giving them every assistance and encouragement in their careers; and upon his recommendation the Directors afforded the employees exceptional and much-appreciated facilities in the direction of attendance at the Science and Art and Evening Schools, with payment of all fees, &c. The Company's successful co-partnership scheme, adopted five years ago, also had Mr. Braithwaite's cordial commendation. Outside his professional work he had few interests, and was, as he had been aptly styled, "a gas man first and last." He joined the Gas Institute thirteen years ago, and passed into the Institution, of which he was a member at the time of his death. He was also a member of the Wales and Monmouthshire District Institution. Deceased was a widower; and he leaves a grown-up family. The funeral took place last Saturday.

That "safest" of all illuminants [according to the electricians] is said to have been the cause of a disastrous fire, with about £10,000 to £12,000 of damage, at Chislehurst last Sunday morning. The report concludes: "So far as can be ascertained, the fire was caused by a fusing of the electric wires over one of the upper rooms."

NOTES FROM WESTMINSTER.

Such little work as there has been in the Committee rooms this session is tailing-off in a gentle manner; and it is only occasionally that an interesting little picking can be obtained from what is intermittently going forward. Several Bills have made further formal progress towards their entry into the Statute Book. The North Metropolitan Electric Supply Company are not going to let the successes all along the line of the Tottenham and Edmonton Gas Company in regard to the electricity supply of Wood Green deter them from making a final struggle to prevent the inhabitants of that area having the electricity suppliers that they prefer. The North Metropolitan Company are showing great hardihood, and a determination to waste their money in contention, in the circumstances; and we think it quite unlikely the second House will go against not only local preference, but the decisions of the first House and the Board of Trade. The water clauses of the Bradford Corporation Bill have gone through, after agreements with certain outside authorities.

Twelve Candles and Calorific Power.

There are one or two points about the Redcar, Coatham, Marske, and Saltburn Gas Bill which should not be passed without notice in this column, though the report of the proceedings to which reference is now being made appeared in the "Parliamentary Intelligence" last week. There are both good and bad points about the settlement which the Company made, and which enabled the Bill to appear before the Unopposed Bills Committee only needing the necessary support to satisfy the Committee as to the proposals. The Company were asking for a reduction of the standard of illuminating power to 12 candles, which would bring the standard down to the level of the neighbouring borough of Middlesbrough. But in consideration of this drop in illuminating power, the Company agreed with the Redcar District Council (who were advised by Mr. Arthur Valon, M.Inst. C.E.) to insert the Wandsworth calorific power clause, and to adopt net figures. What, in the first place, it would be interesting to know is why (if we are not misinformed by the report) the Company did not insist, in adopting a calorific power standard and test, on the cancelling of the illuminating power standard, so as not to be subject to a dual standard. A double standard has not been found of advantage in the case of the Gaslight and Coke Company. The second point is, why did not the Company adopt the all-British form of calorific value clause, precedent for which is to be found in the South Suburban Act of last session, as well as (in accordance with the major opinion of experts) gross and not net figures. It is rather curious to run away from the admittedly, under our British conditions, best form of clause. These are the only criticisms; but there is further interest to be derived from the proceedings on the Bill. From Middlesbrough came the intelligence that no complaints have been received through working to a 12-candle standard; and Mr. Jacques Abady finds that this is actually what is being done, as his tests show that the illuminating power is only between 12 and 13 candles. But the reason there are no complaints is clearly shown by the calorific power of the gas. The tests disclosed (notwithstanding the low illuminating power of the gas) a value of 156 calories gross and 139 calories net, which is good. While consumers are being so well served in the matter of calorific power, they are not, in these days of incandescent burners, likely to make any fuss about the luminous quality of the gas itself. There are other interesting figures in Mr. Abady's evidence. The gas at Redcar (tested by a somewhat old apparatus) showed an illuminating power of about 15 candles; but the calorific power was 153 calories gross and 137 calories net, or rather less than at Middlesbrough with the lower illuminating power. These figures are worth particular attention. The parliamentary authorities are noticing that there is a disposition on the part of gas suppliers to ask for a reduction of illuminating power; and there is renewed talk of inquiring as to how the consumer stands in the matter. The consumer is well protected in these days of sliding-scales and competition. Moreover, instead of troubling to inquire into a matter that is now valueless, the parliamentary authorities would do much better to see what can be done in facilitating, as opportunity arises, the setting-up of the calorific power standard and suppressing the useless illuminating power one.

The Passing of the Lamp Standard.

There are a considerable number of lamp-posts in the country; and there will always be in the streets and roads removed from the bustle and considerable traffic of the intermural streets of our busiest cities and towns. From these, however, there is a passing of the lamp-post. Several examples of central suspension of lamps or suspension from wall brackets are now to be found in London; and Manchester and other places are following the lead. In the City of London, the Corporation have long had the power to make attachment of wires and brackets to private buildings; and now the London County Council are, in their General Powers Bill before Parliament, asking for the same right being conferred on all the Metropolitan boroughs. Sir H. Davies' Committee last week considered the Bill, and allowed the clause, though a point was raised in opposition by the London and North-Western and Great Eastern Railway Companies. It was that there is a prospect that, if wires or brackets are fixed to their buildings, there may be some

interference with their own electric arrangements. The Borough Councils can easily avoid this by adopting incandescent gas-lamps of the modern type in their street-lighting improvements. The Railway Companies did not succeed in obtaining exemption for their buildings. The clause provides that, if there is any unreasonableness on the part of property owners in connection with this use of their frontages, the matter is to be referred to a police magistrate. There will be many who may feel unreasonable, but few who will carry the matter so far as a Police Court, in view of the legislative authority. Public convenience has a fair share of consideration nowadays, though we have not heard of many public complaints regarding the presence of lamp-posts in the streets. As a matter of fact, they are often found very useful by the public, irrespective of their main function.

Playing Many Parts.

Mr. R. Bruce Anderson has this session been playing many parts in connection with the promotion of the Bagnalstown Gas Order. He is Secretary and General Manager to the Company. He acted as Parliamentary Agent for the measure. It was opposed in the House of Lords. He put the case before the Select Committee, went into the chair as witness for the Bill, cross-examined the witnesses for the Carlow County Council, addressed the Committee, and carried the Bill. The Company is only a small one; and Mr. Anderson has been saving it expense. The same course could not be advised in all cases; and even Mr. Anderson, successful as he has been in this instance, might hesitate to fill all the same parts on another occasion under other circumstances. Seeing that the measure was opposed, he has established a record—at all events, during some years past, we do not remember a similar occurrence.

ELECTRICITY SUPPLY MEMORANDA.

THE recent conference of the Incorporated Municipal Electrical Association has not, through the most important subjects being discussed behind closed doors, produced much material for mention in these columns. The President was Mr. J. E. Edgcumbe; but the address on the occasion was delivered by Mr. C. E. C. Shawfield. He complained bitterly of the position in which municipal electricity supply authorities are placed by not being authorized to furnish wiring and fittings; but, on the other hand, he was able to compliment the supply authorities on the reduction made during recent years in the average charges for electricity. Much is being made of supplying at 0·5d. per unit; but, of course, the price is nothing like this when the fixed amount charged on the rateable value of a house (10 to 15 per cent.), as under the Norwich system, is taken into account. It is one of the best pieces of chicanery ever practised on consumers by the electrical industry, in suggesting to them that they are getting electricity at ½d. per unit, though it is true the greater the consumption under the system, the lower the average charge—always above ½d. per unit—to the consumer. The question of the 0·5d. unit in connection with the development of the cooking load was dealt with at a recent special meeting of "Point Fives" Association, at which members of the Municipal Electrical Association were invited to be present. An article on the discussion that then took place appears elsewhere in this issue. To return to Mr. Shawfield, he referred to the competition with gas; and very kindly suggested that, instead of competition, there should be co-operation. He considered the suppliers of gas should devote their energies to the economical production of non-illuminating producer gas, which could be used by the suppliers of electricity for the production of electrical energy. He fancies if—*if!*—such an arrangement were possible, it would assist in husbanding our coal resources, and would bring a little nearer that flat-rate of something less than ½d. per unit, which at present seems rather a Utopian idea. But it is one thing to suggest this; another thing to get electrical engineers to see matters from a common point of view. We will not say anything as to what the gas industry would think of such a project; because what it thought might not be over-complimentary to Mr. Shawfield. But Mr. S. Z. de Ferranti in a paper on "Prime Movers for Electric Power" says the steam turbine is the best thing at present for large generating stations. Other electric engineers say that bye-product recovery gas-producers are the things; and for small stations oil-engines. If, therefore, the gas industry were to hand over its business to the electricity industry, and turned producers of power gas only for the generation of electricity, it might find itself without occupation. But the gas industry is not likely to do anything that is rash—anyway, under present circumstances. It would not be so unkind to the community—nor to itself.

Conferences.

Sceptic, or——What?

We do not know why, when Mr. C. Orme Bastian wants information from us, he should address the envelope containing the inquiry to the "Electrical Times." It is just as easy, or easier, to go a direct route to work as an indirect one. We are not sure, too, whether in dealing with Mr. Bastian he is merely a sceptic, or is absolutely an ignoramus, on the subject of gas-fire efficiencies. However, in his letter to our electrical contemporary, he says that the writer of the "Memoranda" in the "JOURNAL" is apparently rather angry with him, because he (Mr. Bastian) recently pointed out the "generally acknowledged fact" that about 80 per cent. of the thermal units generated in a gas-fire are wafted up the necessary chimney in the form of hot air or hot gaseous products of combustion. We were not angry with Mr. Bastian; we are only sorry for him. As to the "generally acknowledged fact," it is not a fact; and there are only about two people who "acknowledge" it—Mr. Bastian and "Meteor." Of course, they may consider that they are the only two persons capable of expressing an opinion upon it. Following this remarkable display, Mr. Bastian says that "the tests carried out at the Leeds University by Professor Bone, F.R.S., have little bearing upon the subject." But he judiciously neglects to explain for the edification of the scientists—not only Professor Bone but others—who have been engaged on these and other tests, how it is that they have no bearing. We cannot accept his method of brushing these tests on one side in this way, and must ask for an explanation before going any further. Mr. Bastian invites us to point out how the Leeds University or any other tests can be interpreted to disprove his contention. Now if Mr. Bastian will betake himself to the Patent Office Library—or the environment of the British Museum would perhaps be more suitable—and study [see the "Transactions" of the Institution of Gas Engineers for 1909 and 1910] two reports by the Gas-Heating Research Committee and their Research Chemist (Mr. E. W. Smith, M.Sc.), signed by Professor Arthur Smithells, F.R.S., Dr. W. A. Bone, F.R.S., Professor Cohen, and Messrs. John Bond, J. H. Brearley, and Charles Wood, he will find the answer for himself—remembering the improved construction of gas-fires as (partly) one of the results of these investigations, and which has raised the radiant efficiency of modern gas-fires (to say nothing of the convected heat) to above 50 per cent. While at the Patent Office Library or the British Museum, he might study the Glasgow experiments [see "JOURNAL" Jan. 4, 1910]; and he will learn something more. But, coming nearer to the present time, in the "JOURNAL" for June 10 (p. 723), he will find in Table I. the results of some tests by Dr. Bone; and in Tables II. and III. the interpretation thereof. Table III. particularly will answer the question put by Mr. Bastian. If these reports and tests are not clear enough for him, then we are extremely sorry —— for Mr. Bastian. Will Mr. Bastian and "Meteor" kindly give the names of the gas-fires, and describe the nature of the tests they have made (just as the Gas-Heating Research Committee have done in their reports) which justify their assertion that about 80 per cent. of the thermal units generated in a gas-fire are (as in the case of a coal fire) wafted up the chimney. We have asked for this before, but all the response is the hard stone of generalization, and a statement of foolish belief, without any foundation for it being offered. The difficulty in which Mr. Bastian and "Meteor" are placed is that they know full well they have no foundation whatever to offer. Why do they not own up to it, or produce their justification?

Blind Electrical Criticism.

In an article, headed "Mr. Horsnaill's Ignorance," "Electrical Industries" displays a considerable amount of that same quality—more, in fact, than Mr. Horsnaill. It seems that this gentleman, who is an Associate Member of the Institution of Electrical Engineers, has been writing an article in "The Standard" on the subject of "The Truth about Electric Cooking and Heating." Mr. Horsnaill deals with the old question of meat shrinkage in respectively gas and electric ovens, and points out that the relative wastage is largely a question of temperature control, though he imagines that, with air entering at the bottom of a gas-oven, and passing out of it at the flue-vent, may account for more evaporation of moisture from a joint than in an unventilated electric-oven. There is a considerable amount of nonsense electrically spoken and written about this subject. If the temperatures of gas-ovens are properly controlled, there is no more waste than in an electric-oven—that is if the meat is cooked equally. Using a proper temperature that will quickly coagulate the exterior of the joint, evaporation by the slow-passing air currents (the humidity of which is increased not alone by evaporation from the food being cooked, but by the water vapour arising from the combustion of the gas) must be modest indeed. It is not dehydrated air that passes through the oven; nor air that has been dried by the convection heat of what electrical humorists call electric "radiators." On the other hand, if an electric-cooker is not ventilated, there is little chance of the outsides of a joint becoming properly coagulated, or the joint properly cooked, as it quickly comes about that there is nothing surrounding the joint in the oven but steam supersaturated atmosphere, produced by evaporation from the joint itself—there being no other source of moisture. Under the relative circumstances, we can quite believe that the nutritious juices of a joint have a greater chance of escaping in the unventilated electric-oven than in the gas-oven. The writer in "Electrical Industries" accounts for the supposed difference in shrinkage by the "easy and accurate control" of temperatures in electric-ovens. There is no accurate control; and there cannot be. The current consumption is definitely arranged at (say) four points. The claim is made that there is very slow dispersion of heat from the electric-oven. Therefore, when a change is made from (say) full energy consumption to half consumption, with the overlapping of temperatures that goes on, where does "easy and accurate" control come in?

Evaporation, and Other Points.

Mr. Horsnaill states that the loss by evaporation from a joint is only water; the writer in "Electrical Industries" says that is a ludicrous statement. But he does not stay to say why. Now before electric cooking becomes the universal mode, as we are told by electrical prophets it is to be, we should like to know whether these gentlemen who talk about "pemmican" and suchlike as being the product of a gas-oven, have never tasted anything of a succulent and juicy character in the way of baked meats at some of the noted hotels, restaurants, clubs, and cafès that abound in the West-end, in which gas cooking is almost universal, and the maintenance of which palatial places depends upon the character of the food served to their patrons. The cook, of course, is the principal factor in this wastage question—no matter whether the heat be obtained by means of gas or electricity. The electrical people are far from comfortable over the closer study that this shrinkage question is receiving at the hands of the gas industry, and over their findings—findings of a much more reliable character than the old figures (universally applied figures for all cooks, stoves, temperatures, and methods) for gas and coal oven heating from old cookery books. The electrical people, too, will insist on keeping off the large percentage of work done on the top-plate, and confining themselves to the small percentage of work done in the oven. In the campaign, if such it can seriously be called, gas undertakings will see that the public receive satisfactory information on this point. Maintenance and reliability are also good subjects. The gas-cooker at present in the house of the writer of the "Memoranda" has been in daily use for eight years for all meals, and for the first time, it has been, this last spring, overhauled by a man from the gas company. The only renewals required were the grill-plates and the oven tins—not even a new oven burner was needed.

Assisted Wiring.

Some kind soul connected with the Brighton Corporation Electricity Department has sent "Memorandist" some meagre printed particulars concerning the assisted wiring scheme that is in operation in Brighton. We wish he had been a little more hearty over the quantity of the information. Under this scheme the little card to hand tells us electricity is supplied at the usual flat-rate of 4d. per unit, through a shilling-in-the-slot meter, with an additional penny only until the cost of the installation has been paid off. On the next page we find that the average cost of using installations already fixed on this plan works out to less than 1s. per week inclusive. This being so, it shows that about 2 units of electricity per week are consumed, which represents a contribution of only 2d. towards installation, or 8s. 8d. per year per dwelling; and this means that the wiring and fittings, including meter (who, by the way, bears the cost of maintenance and renewal embracing lamps?) will not be paid for before the day of scrapping comes, unless it is as modest as the information sent to us. Why, if there are half-a-dozen lamps in the place, it will take much more than the 8s. 8d. to renew them annually. No information is given as to the number of lamps used in these under-a-shilling-a-week installations, the candle power of the lamps, and so forth. Among the other statements made on the card is that "one unit of electricity will 'light' one 16-candle power lamp for 50 hours, or will 'light' one 32-candle power lamp for 25 hours." Will the Brighton Corporation Electricity Department guarantee those candle powers, consumptions, and hours? If so, perhaps the same kindly person who sent the card will tell us whose lamps they are with which they are able to guarantee 1-candle power per watt-hour. At the bottom of the card, it says: "If you desire further information, please fill in, and return the enclosed post card, and a representative will call to advise you free of charge." There was no post-card enclosed, so that we could not fill it up. We should rather like to put a representative of the department under examination for a short space regarding this matter.

West Ham and a New Tariff.

At West Ham an attempt is going to be made to create a heating and cooking load by the adoption of a tariff which, it is hoped, will be seductive enough for the purpose. But West Ham is not Belgravia; and so we shall watch the course of the new movement in this East-end borough with a considerable amount of interest. A long report prepared by the Electrical Engineer (Mr. J. W. Beauchamp), introduced the matter to the Borough Council. Mr. Beauchamp has not been long at West Ham; and therefore it is a very laudable thing on his part to emphasize his advent as chief by proposing an innovation of some kind. In his report he states that in London a large amount of work has been done in converting restaurants to electrical operation. We should be extremely pleased if Mr. Beauchamp would name the restaurants, state comprehensively who are at the backs of the converted ones, and state whether or not he can trace any connection between these restaurants and electricity supply departments. Of course, he ought to be in a better position for doing this than we are; and therefore we shall be obliged to him for any information he can tender on the subject. In considering the question of altering the tariffs, we understand he took into account, among other points, a cost that would compare with gas or coal for heating and cooking, and one which would encourage the use of electricity for lighting cupboards, cellars, &c.! Mr. Beauchamp thinks that 3d. per unit for lighting is already quite low in comparison with gas at 2s. 6d. per 1000 cubic feet—that is to say, he apparently regards it as cheaper to pay 3d. for 800 candle-hours than 3d. for 2000 candle-hours. He also states that ¾d. per unit is a figure which experience has shown to compete very favourably with gas at 2s. 6d. per 1000 cubic feet for cooking. Cooking by a gas-stove takes in all sorts of baking, boiling, frying, grilling, and other operations; we assume Mr. Beauchamp includes in the term cooking all that a gas-cooker is expected to do, and can do. If this is so, then we should like to know something more about the experience of which he speaks, in order to ascertain the extent of the reality or fiction there is about it. What Mr. Beauchamp proposes is a fixed charge per annum payable quarterly in advance, based on the number and capacity of the lamps installed, allowing off such a number and capacity up to 25 per cent. in order to encourage the use of lamps in cupboards, cellars, &c. We do not know if the lay councillors exactly understood what Mr. Beauchamp meant by this (we take it the electrical paper before us has quoted him correctly); but if they all did, they are extremely clever men. Then, in addition, he proposes a further but smaller fixed charge per annum payable quarterly in advance, based upon the capacity of heating, cooking, or any other electrical apparatus in a house. Supplementary to the fixed charges, ½d. per unit used will be registered against the consumer. If Mr. Beauchamp wants to frighten people from his tariff proposal, we should think he has succeeded admirably.

COMMENTARY ON THE PRESIDENTIAL ADDRESS OF SIR CORBET WOODALL, D.Sc., M.Inst.C.E.

JUBILEE MEETING, INSTITUTION OF GAS ENGINEERS.

By a Lady present.

It would seem appropriate, as it were otherwise ungracious, to allow the masterly and eloquent address of the distinguished President of the Institution of Gas Engineers to pass into history without voicing the keen appreciation of those members of what is, by chivalry, known as the fair sex, for a presidential address of unprecendented interest, lucidity, and compelling charm.

We had almost wished that, like Tennyson's "Brook," it might "go on for ever;" for not only did Sir Corbet Woodall reveal himself as an orator of the highest degree, but his address was a perfect research of literary gems, each one of which was so aptly placed as to illumine the whole, and leave no room for a shadow to darken even those parts necessarily devoted to technical, and what, I fear, ladies often term "dry," matters.

In truth, the Institution is honoured and embellished by the presidency of Sir Corbet Woodall in this Jubilee year. Not alone by his brilliant rhetorical effects combined with a pristine purity and simplicity of language which betoken the gifted *litterateur*, but by his keen, practical insight into, and long experience in, the great industry he represents, allied to a broad sympathy with the *personnel*, does he render us immeasurably his debtor.

Leaving the more technical portion of the address to the competent judgment of the gentlemen privileged to hear it, and confident of their appreciation, might I, as one of that probably larger body of women who create a demand which they labour to supply, record sincere gratitude to the President for the depth of understanding sympathy that he evinces in his remarks regarding the workers. The way in which he sets forth their difficulties and needs is *primâ facie* evidence that he has gone to the bottom of this thorny problem; and it might be well before criticizing the means whereby Sir Corbet Woodall hopes to find a permanent amelioration of grievances—the system of co-partnership—to bear in mind that he gives the weight of practical experience to his recommendation, and speaks, "what he knows."

Finally, by brief references to such things as "National Service" and "Citizenship," Sir Corbet Woodall gives us not the least pleasant *bonnes bouches* of his address; for it is just here we are all so prone to forget, and merge the man into the machine—oblivious of the great obligations both employers and workers have in guarding the destinies of our great and mighty Empire, in the doing of which each mother's son—aye and (without entering current controversy on suffrage) each son's mother—has a definite part; and it is well here to be reminded that "man cannot live by bread alone!"

The Presentation to Mr. Thomas Newbigging.

The writer of "The Observatory" column in last Saturday's "Manchester City News" makes the following remarks regarding the presentation to Mr. Thomas Newbigging at the recent meeting of the Institution of Gas Engineers, of his portrait, painted by Mr. Tom Mostyn: "The members of the Manchester Literary Club, with which Mr. Newbigging has been so closely identified for so many years, as well as his other friends here in the city as elsewhere, will join in the congratulations on this latest expression of goodwill and esteem to one who has made life richer and better by his labours, professional and otherwise. He has had a long and strenuous life, has graced literature with his pen in a variety of ways, and takes a wide outlook on men and things. In the present issue of the 'City News' will be found an appreciation of the latest edition of Mr. Newbigging's 'Handbook' on gas engineering—a most valuable work in its way."

GERMAN ASSOCIATION OF GAS AND WATER ENGINEERS.

FIFTY-FOURTH ANNUAL GENERAL MEETING AT STRASSBURG, June 23 to 27.

A REVIEW OF THE PROCEEDINGS.

[By Our Special Representative.]

The Fifty-Fourth Annual General Meeting of the German Association of Gas and Water Engineers was held last week at Strassburg, in Alsace. The Association last met in the city in the year 1891; and many changes have been made in the interval in the gas-works plant, in public lighting, and in connection with the water supply. But the Strassburg Gas-Works, which belong to the Compagnie l'Union du Gaz, of Paris, have been on the same site for over seventy years; and there is no reason why, with the increased productive capacity which modern carbonizing plant affords, the site should not suffice to meet the rapidly-growing requirements of gas consumers for many years to come. The works present many points of great interest both historically and technically, as will be seen later.

The Inaugural Assembly.

The customary evening assembly took place on Monday in the principal restaurant of the Orangerie—a delightful park on the outskirts, to the north-east, of Strassburg. It is named from the fine orange-trees which, planted in large tubs, were standing in the open, laden with fruit. In the winter months, they are kept under glass. Here those present were entertained by the Local Reception Committee at supper. After the meal, a varied programme of song and recitation was provided, and, outside, the large lake, with its surroundings, was beautifully illuminated. Many pretty and unusual effects were obtained on the water, rocks, and trees, redounding much to the credit of the electrical engineers responsible for them, for strange to say no gas was used. Gas men, however, were not greatly concerned at this apparent neglect to utilize their commodity; for it was explained that no gas-main had been carried near the lake, whereas a connection could be readily made to an electric cable not far distant.

The Association were welcomed to Strassburg by Dr. Leoni—a deputy who represented the Burgomaster. He assured those present that the peace-loving and friendly people of Alsace would do everything possible to make the visit a pleasant and memorable occasion for all. He referred to the prosperous gas undertaking of Strassburg, and expressed the hope that the meeting would tend to cement the bond of friendship of the Alsatians with their old German colleagues. Thanks for the hearty welcome were expressed on behalf of the Association by the President, Herr Reese, of Dortmund. He said they all welcomed the opportunity of coming to Alsace, in order to grasp hands with their brethren of the Imperial Territory of Alsace-Lorraine. He concluded by giving the toast of Strassburg, which was honoured with the greatest enthusiasm. The programme of song and recitative contained many items in the Alsatian dialect, which is still widely spoken, and is linguistically of considerable interest.

Opening of the Technical Proceedings.

The technical proceedings began last Tuesday morning in the large salon of the Concert Hall of the Strassburg Choral Society. The attendance was good, and did not appear to fall short of that at other recent annual meetings of the Association, though the list of participants in the gathering, compiled up to that day, showed only 752 names, including some 70 ladies. It may be surmised that the majority of those present were really interested in the technical proceedings, and that the additional 300 to 400 members and guests who have been present in many past years have primarily regarded the meeting as an attractive social function and excursion.

So far as the technical proceedings were concerned, the Strassburg meeting will compare very favourably indeed with its predecessors—and in some respects it benefited by the relative paucity of the holiday-makers. The absentees, however, would have been well catered for, as the Local Committee had provided an admirable programme of entertainment and excursion, with extensions for those who had more time at their disposal; and the smoothness with which all was carried out testified to their organizing and administrative powers.

The meeting was formally opened by the President, who in a happily-phrased speech, welcomed members and guests. He referred to the recent celebration of the twenty-fifth anniversary of the accession of the Emperor William, to whom German technology and industry and German technical men owed a deep debt of gratitude. This had been recognized by the technical colleges in the conferring on the Kaiser of the degree of Doctor of Engineering, which he had been pleased to accept. He proposed to send a telegram (on behalf of those present) to the Kaiser, who had thus shown his great concern in the technical progress of the Empire.

The Director, Herr V. Traut, welcomed the Association in the name of the Ministry of the Province, which he said took very great interest in the proceedings. He was particularly pleased to see that among the papers to be read was one dealing with the water supply of Alsace-Lorraine. He wished success to their deliberations. Dr. Schwander, the Burgomaster, then welcomed the Association to Strassburg. He said that it was largely due to the work of the Association that Germany was not now behind other civilized countries in matters of municipal hygiene and comfort. Formerly this was not the case; and the change had been mainly effected through the activity of the members of the Association. There still remained, however, much progress to be made; and he trusted that their sittings would have good results. He hoped that all those present would retain very pleasant memories of their visit to Strassburg.

Dr. Sartorius Baron von Waltershausen, Professor at the University, spoke on behalf of that institution, in which, he said, the theoretical side of the sciences of chemistry, physics, economics, and geology held first place. The Association represented applied, as distinct from theoretical, science—being concerned primarily with the immediate requirements and purposes of life. Theoretical science embodied in itself its highest aims, and sought to discover the interdependence of things in Nature. But this in no way implied that there was an uncrossable line between it and practical science. The connecting link was afforded by the applied sciences of chemical technology and social hygiene, for which provision was also made at the University. He hoped that the manifold relations of science with the objects of the Association would develop to the welfare of the people. By the concurrence of science and practice, Germany had in many directions become economically great, and international competition would lead to improvements of which the people at large would reap the benefit. Herr Eisenlohr, a Deputy of the City, spoke on behalf of the Association of Architects and Engineers of Alsace-Lorraine, who he said had always very pleasant relations with the gas and water engineers. Herr Weiss, the Manager of the Zurich gas undertaking, said a few words for the foreign Associations and technical men present, and Heer M. Levert, of Apeldoorn, expressed the good wishes of the Dutch Association.

Presidential Address.

The President thanked all those who had spoken for their good wishes, and proceeded to review the events of the past year. The Association had lost ten members by death, among whom he signalled out for special mention Herren Oldenbourg, Stende, and Herzberg. Delegates had represented the Association at the jubilee in the previous week of the English Institution of Gas Engineers, from which they had brought very gratifying messages. The Association congratulated the Institution on the attainment of its jubilee, and wished it all success in the future. The Central Gas Propaganda Organization had done much good work in the past year, and was now arranging for a great gas exhibition to be held at Munich. The formation of the German Illuminating Engineers' Society was a matter of some importance for furthering the interests and objects of German lighting engineers. The gas industry would be equally represented with the electrical industry on the Commission for Standards of Light and Nomenclature. Competition with electricity had resulted in advance, and both industries had reaped advantage therefrom. Further progress had been made in the distribution of gas at high-pressure from central works to places at a considerable distance. The President proceeded to refer in some detail to the Prussian water law, and said that a uniform law was eminently desirable. He then mentioned methods for destroying organic matter in water. The use of chloride of lime met with the disapproval of the public, on account of the bad taste which it gave to the water. Better results had been obtained with gaseous chlorine, which could be produced by the electrical dissociation of common salt; but the process was too costly for general adoption. It would be best if the law would allow of water being brought by co-operative arrangements from the mountains to the towns.

Herr Körting on Gasholder Construction.

The first gas communication was a paper by Herr Körting, the General Manager in Berlin of the Imperial Continental Gas Association, on "Gasholders." Herr Körting read only portions of the paper, of which copies had been distributed at the meeting. An abstract translation of this interesting contribution, which referred chiefly to the cost of construction of gasholders and the means of securing a sufficient margin of safety, is given on p. 37 of to-day's "Journal." Before reading his paper, Herr Körting reported to the meeting that he, with Professor Hans Bunte, of Carlsruhe, and Herr Prenger, of Cologne, had, the previous week, represented the Association at the jubilee celebration of the English Institution of Gas Engineers, by whom, he said, they had been most cordially received and lavishly entertained.

The inaugural speeches and one water paper had occupied so

much of the five hours allotted to technical proceedings out of the day, that Herr Körting found it difficult to present even a brief *résumé* of his paper and leave any time available for the other two communications put down in the day's programme. As a matter of fact, one was deferred to the following morning.

Flameless Surface Combustion.

The one taken was a lecture, with demonstrations, by Professor Hans Bunte, on "Flameless Surface Combustion;" but, unfortunately, it had to be greatly curtailed, owing to lack of time. The lecturer showed first the well-known property of platinum foil, when warm, of effecting combustion of gas impinging on it, until, owing to the consequent rise of temperature, the gas is ignited. He showed also that a similar phenomenon may be observed with an extinguished spirit lamp, and demonstrated the action of platinum wire and platinum black, as discovered by Dobereiner, in igniting the gas in a mixture of gas and air. He then passed on to refer to the development of surface combustion, based on the observations of Sir Humphry Davy, which had recently been made by Professor Bone in England and Herr Schnabel in Berlin. He showed how a porous fire-clay tile, fed on one side with gas and air under pressure, effected flameless combustion of the gas within the pores of the tile, bringing the face of the tile to bright incandescence, while the back remained cool. He also showed, in action, a crucible furnace and a muffle-furnace, packed with porous refractory material, in which the flameless combustion of gas by air under pressure was similarly effected. It became possible, by these means, to secure the combustion of a large volume of gas in a very small space, and a heating efficiency of 80 to 90 per cent. was thereby attainable. The heat which a cubic metre of clay was able to contain was to the heat held by the same volume of gas as 2000 to 1, but the thermal conductivities were as 100 to 1. The ratio of the heating surface of a Bone-Schnabel boiler or heating-tube to that of an ordinary boiler or heating-tube was as 15,000 to 1. The lecturer briefly referred to curves showing, for coal gas, mineral oil, Saar coal, and carbon, the relation between the proportion of carbonic acid in the flue gases and the probable initial temperature attained, depending on the rise in the specific heats of the gases.

In the discussion which followed the delivery of this lecture, Herr R. Blum, of Berlin, stated that experiments had been made which showed that flameless surface combustion could be effected, by the use of porous and not fragile material, with air and gas at ordinary pressures. The method of combustion had thus become applicable to gas-cooking apparatus, irons, &c., and an economy of 40 per cent. of gas might be obtained as compared with existing apparatus. Other experiments had demonstrated that the process was applicable to the heating of bakers' ovens, central heating plant, and industrial furnaces. Flameless surface combustion could also be extended to tar oils, which could thus be burnt without smoke or deposition of carbon.

Visit to the Strassburg Gas-Works.

The sitting on Tuesday morning closed with the discussion on Professor Bunte's lecture. In the afternoon, the members divided into four groups, one of which visited the Corporation water reservoir at Oberhausbergen, another the electricity works, a third the garden suburb of Stockfeld, and the last, and numerically strongest, group the gas-works.*

The latter works are situated in the heart of the city, alongside the old railway station, which is still used for a small amount of local traffic and for perishable produce. When the new railway station was opened for traffic in 1884, the gas-works obtained a portion of the adjacent site of the old railway station; and they now cover an area of over 8½ acres. The old railway connections serve for bringing coal and other materials from wharves on the Rhine, or from the general railway system. The works were almost completely demolished by the Prussian artillery in 1870, in which year no gas was made from the 14th of August to the 24th of December. Rapid reconstruction (having regard to the difficulty in obtaining materials and labour at the close of the war) followed; but it was not until 1872 that the gas consumption again attained the level of 1869.

Carbonizing Plant.

The carbonizing plant at the gas-works comprises thirteen Klönne regenerative settings, each of nine through retorts, 21 feet long. The retorts are Ω-shaped, 23 inches wide and 16½ inches high. Each setting has its own producer, which extends in front of the face of the setting in order to facilitate firing. The ascension-pipes are on the discharge side only; and a coke trough-conveyor runs in front of the bench on this side. On the charging side, there are coal-bunkers above the settings, and two Fiddes-Aldridge stoking machines. The latter have been installed for over four years; and during eighteen months one machine did the whole of the stoking without failing for a single charge. Each machine is driven by a single direct-current motor of 13½-H.P.; the current being supplied at 220 volts. Formerly light charges were worked off in six hours; but for a year past charges of 11·8 cwt. have been worked off in 7 hrs. 12 min. The make of gas is from 11,650 to 11,850 cubic feet per ton of 70 per cent. small and 30 per cent. large coal. Allowing for all possible contingencies, thirty retorts are discharged and re-charged in an hour by one machine. With an ample provision of labour, the retort-house wages, for the present output of about 600 million cubic feet per annum, do not average above two-thirds of a penny per 1000 cubic feet, and they will become lower as the output increases. The current required by the machines averages 0·04 unit per 1000 cubic feet. The coke consumed in heating the settings amounts to 12·3 to 12·5 per cent. of the weight of coal carbonized. The retorts are scurfed once in six weeks. The production of the Strassburg gas-works is supplemented by that of the gas-works in the suburb of Kiel, where the old works, on being taken over by the Company, were reconstructed in 1905, and a high-pressure main was laid from them to a reducing governor on the Strassburg distributing system. A Roots blower is used for pumping the gas from Kiel to Strassburg, except in the summer months, when the holder pressure at Kiel is adequate to transmit the necessary quantity.

Stoking Machinery and Public Lighting.

The chief interest of the gas-works centred in the stoking machinery, of which there is only one other installation of the same type in Germany. A full description of the works was, however, presented to each participant in the meeting. It was embodied in a tasteful large-page volume, divided into two main sections. One of these gave a history of the public lighting of Strassburg from its beginnings in the seventeenth century to the present date, and the other gave an account of the gas-works. Public lighting, unfortunately, is passing out of the hands of the Gas Company, owing to an agreement between the Corporation and the electricity supply undertaking (in which the Corporation have a controlling interest), by which the latter are to supply 500.000 units of current per annum for public lighting free of charge, and further current for the same purpose at about ⅓d. per unit. Owing to current being obtainable on these terms, large metallic filament lamps, of which the maintenance costs are low, will be generally used in place of arc lamps (with higher maintenance charges), notwithstanding the lower current consumption of the latter. The contract which embodies these economically unsound principles, by which gas is virtually excluded from participation in the public lighting, extends to the 1st of April, 1922. The Gas Company's present concession for the supply of gas in Strassburg terminates at the end of the year 1932.

While the visitors were at the gas-works, a large balloon was filled, and ascended with four passengers. The ascent was a matter of some difficulty and danger in the cramped space available, and with the surrounding high structures. It was subsequently reported that the balloon had made a safe descent near Freudenstadt, in the Black Forest.

The Sterilization of Water.

At the close of his Inaugural Address, the President called upon Dr. Gärtner, Professor at Jena, to read a paper on "The Present Position of Recent Methods of Sterilizing Water for Drinking Purposes." Before giving his communication, Professor Gärtner expressed his warm thanks for the honour which the Association had conferred upon him in bestowing the Bunsen-Pettenkofer Medal on him. He classified methods of sterilizing water under three heads—viz.: (1) By chlorine, (2) by ozone, and (3) by ultra-violet rays. Chlorine itself did not effect the sterilization, but it acted indirectly through the oxygen which it liberated. The chemical reactions of chloride of lime, showing the liberation of oxygen, were illustrated by the following equations:

$$\text{I.}—2\,Ca\begin{matrix}Cl\\OCl\end{matrix} + 2H_2O = 2HOCl + CaCl_2 + Ca(HO)_2$$

$$HOCl = HCl + O.$$

$$2HCl + CaCO_3 = CaCl_2 + H_2O + CO_2$$

$$Ca(HO)_2 + 2CO_2 = Ca\,H_2(CO_3)_2.$$

$$\text{II.}—2Ca\begin{matrix}Cl\\OCl\end{matrix} = CaCl_2 + Ca\begin{matrix}OCl\\OCl\end{matrix}$$

$$Ca\begin{matrix}OCl\\OCl\end{matrix} + H_2O + CO_2 = CaCO_3 + 2HOCl$$

$$HOCl = HCl + O.$$

$$\text{III.}—NaOCl = NaCl + O.$$

$$\text{IV.}—Cl_2 + H_2O = 2HCl + O.$$

$$\text{V.}—Na_2SO_3 + Ca\begin{matrix}Cl\\O\,Cl\end{matrix} = CaCl_2 + Na_2SO_4.$$

$$\text{VI.}—Na_2S_2O_3 + Ca\begin{matrix}Cl\\OCl\end{matrix} = CaCl_2 + Na_2SO_4 + S.$$

$$\text{VII.}—Al_2(SO_4)_3 + 3CaCO_3 + 3H_2O = 2Al(HO)_3 + 3CO_2 + 3CaSO_4.$$

For the effective use of chlorine, however, the water ought not to contain more than 100 organisms per c.c. Colonies of bacteria should be kept back by previous filtration. The epidemics in the Lower Ruhr district in 1911 demonstrated the favourable action of chlorine, as the typhus mortality was checked by its use. The

* In regard to our Correspondent's account of the visit to the Strassburg Gas-Works, it may be mentioned that an illustrated description of the works appeared in the "JOURNAL" for Jan. 4, 11, and 18, 1910, pp. 26, 93, and 158.—ED. J.G.L.

author gave the appended tables to show the beneficial action on organically impure waters of treatment with chloride of lime.

TABLE I.—*Bacteria per C.C. of a Highly Dangerous Water of a Ruhr Works, without and with Addition of Chloride of Lime.*

Date.	Ruhr Water.	Wells Examined.			At Taps.	Remarks.
		Best.	Worst.	Average.		
1911.						
Sept. 13	1,480,000	4	3000	1000	34,200	No chloride of lime used.
,, 14	1,292,000	4	7552	3936	4,090	Very bad period.
,, 15	1,032,000	12	693	2304	1,664	
,, 16	321,000	5	6080	6128	5,504	
Dec. 17	51,700	23	941	309	13	Chloride of lime added at the collecting wells in proportion of one part to one million.
,, 18	18,300	7	283	83	2	
,, 20	43,700	11	353	152	8	
,, 21	56,100	53	429	193	2	
1912.						
Jan. 15	41,900	69	1000	158	2	Chloride of lime added.
,, 16	36,400	77	1900	123	0	
,, 22	48,300	76	449	463	423	No chloride of lime used.
,, 23	..	61	746	588	571	
Mar. 4	39,800	49	637	159	1	Chloride of lime added.
,, 5	..	47	409	111	102	No chloride of lime used.
,, 6	39,100	52	339	85	86	

TABLE II.—*Bacteria in the Water of a Ruhr Works in a Better Situation. The Effect of Adding Chlorine at the Collecting Wells when the River Water was Bad and when Good.*

Date.	Number of Bacteria Per Cubic Centimetre.								Remarks.
	Ruhr Water.	Six Wells.						Taps.	
1911.									
Sept. 25.	296,104	1868	728	552	1638	164	376	64	Very bad period; very many bacteria and much organic matter in water. Chloride of lime added in proportion of 1 to 1 million.
,, 26.	338,116	556	2355	284	388	152	128	48	
,, 27.	292,608	540	164	572	812	348	416	56	
,, 28.	—	736	608	168	620	156	332	52	
,, 29.	247,528	972	236	104	128	124	324	34	
,, 30.	286,104	682	452	384	198	198	264	46	
1912.									
April 15.	28,614	24	35	17	32	12	49	0	Better conditions. Chloride of lime added in proportion of 1 to 1 million.
,, 16.	35,750	51	22	23	18	44	124	0	
,, 17.	31,072	40	34	26	22	19	33	0	
,, 18.	42,106	28	22	25	26	14	58	0	
,, 19.	19,740	18	21	34	23	16	46	0	
,, 20.	27,156	49	42	19	54	48	67	2	

In America, where the consumption of water was greater, and shallow well or surface water was used to a larger extent, good results should be obtained from the use of chlorine. The want of chemical knowledge of most water engineers in Germany made them distrustful of chemical measures for the treatment of water. Taste and smell could be removed from water by other suitable means, and, moreover, the public would soon become accustomed to the chlorine-treated water. Germany, fortunately, had good supplies of water generally; but in times of epidemic and in the less favourably situated places, chlorine treatment would be of the greatest possible service.

With regard to the treatment of water by ozone, Dr. Gärtner said that the results obtained thereby surpassed those obtained by chlorination. They were not, however, so potent in regard to the combating of epidemics. When an epidemic occurred, it was possible at once to throw chloride of lime into the water, but it was not possible to provide ozonizing plant so quickly. It had, however, been demonstrated at Paderborn that ozone could overcome an epidemic, and very good results had been obtained with it at Chemnitz. The ultra-violet rays had the great advantage that they killed the bacteria. They would act in a depth of 12 inches of water; but practical experience with them was comparatively restricted up to the present, because of the technical difficulties which the quartz lamps, in which mercury vapour was raised to incandescence, presented. The working became unreliable; the lamps were very fragile; and there was trouble in securing the play of the rays on the water. But these difficulties would undoubtedly soon be overcome.

The Alsatian Theatre.

In the evening, the Municipal Theatre was filled by the members for a special performance by the Alsace Theatre Company of a comedy "D'r Herr Maire." The book, being in the Alsatian dialect, had to be interpreted by most of the audience through the actions of the company, which was formed some years ago to assist in preserving the knowledge of the Alsatian tongue and in promulgating its literature. The acting throughout was of a high order of merit.

Reciprocities.

Before proceeding to the technical papers on Wednesday morning, the President read an acknowledgment from the Kaiser of the telegram which had been sent to him on the previous day, and a telegram in English, signed by Sir Corbet Woodall and Mr. W. T. Dunn, as President and Secretary respectively of the Institution of Gas Engineers, conveying the greetings of the Institution, and referring to the pleasure with which the previous week they had received the delegates of the German Association. The kindly greetings thus conveyed were acknowledged by hearty acclamation. The President then expressed the thanks of the Association to the Gas Company, and Herr Ruhland, the Manager of the Strassburg Gas-Works, for the *brochure* relating to them which has already been referred to, and a copy of which had been given to each member.

The "Athion" Process of Sulphur Purification.

The President then called upon Professor Knoevenagel, of Heidelberg, to read a paper on the "Removal of Carbon Bisulphide from Gas, with Special Reference to the Athion Process." The paper was followed by one on the same subject by Herr Kuckuk, the Manager of the Heidelberg Gas-Works, where the process is being tried on a practical scale.

Professor Knoevenagel referred to the fact that oxide did not remove all the sulphur compounds from gas, but left in it carbon bisulphide, thiophene and its homologues, and small quantities of other sulphur compounds. He said that it was very desirable that they should be removed, as the sulphurous acid produced by their combustion vitiated the air, and attacked the metal parts of burners and apparatus, and even the glass chimneys of incandescent burners. He stated that none of the processes hitherto proposed for the removal of sulphur compounds had proved satisfactory in practice. [He mentioned only in general terms catalytic or contact processes, and probably was not aware of the extent to which Evans's process is now being used by the South Metropolitan Gas Company.] He then proceeded to refer to the alkaline preparation of cellulose, known as "Athion," which in the absence of carbonic acid absorbs carbon bisulphide. The process itself is described in the paper by Herr Kuckuk, of which an abstract translation is given on p. 34. These two papers overlapped to a considerable extent; but Professor Knoevenagel confined himself mainly to the theoretical side of the process. He referred, however, to a diagrammatic view of plant for the application of the process on gas-works. But this also may be more conveniently described in connection with the paper by Herr Kuckuk, who referred to the same diagrammatic drawing. Professor Knoevenagel was inclined to exaggerate the evils alleged to arise from the products of combustion of the sulphur compounds in oxide-purified gas; but he laid stress on the fact that a convenient and economical process of sulphur extraction would render available for gas making some sulphurous coals which it was considered undesirable to use at the present time.

Papers on Water Supply.

The rest of Wednesday morning's sitting was devoted to the reading and discussion of the following papers on Water Supply—viz.: "The Water Supply of Alsace," by Herr Berger, of Strassburg; "The Geological Structure and Underground Water Conditions of Alsace," by Dr. Feeser, of Strassburg; "The Use of Sulphate of Alumina for Clarifying Water at the Elbe Water-Works of Hamburg," by Herr R. Schröder, of Hamburg; and "Roman Water-Mains," by Dr. Jaenger, of Strassburg. The last-named referred particularly to some clay pipes which had been recently discovered during re-building operations in Strassburg, and to the pipe which had been traced from a spring at Rüttolsheim, about 12 miles distant, to Strassburg. The course lay through hilly country and displayed great technical knowledge and ability on the part of the Roman engineers responsible for it. There was a fall of nearly 200 feet from the source to the town. Some portions of the main which were exhibited showed that it was from 6 to 8 inches in internal diameter and made of burnt-clay spigot and socket pipes, in short lengths. The pipes were apparently enclosed in many places in a rectangular culvert. The date of its construction was believed to be about 200 A.D.

Visits to Works, &c.

On the afternoon of Wednesday, the members divided into four groups, one of which went to the wharves; another to the Hospital, where recent extensions are provided with arrangements for heating the interior from a central station some distance away; another group went to the Niederburg Laundry, where high-pressure gas is used; the fourth and largest group went to the Danubia Gas and Water Meter Works. These works, which belong to a company who have also large manufactories in Vienna and Budapest, are very well equipped, and several novel types of igniting devices for gas lights, indoor and outdoor, attracted notice. The majority of these were actuated electrically. Some good castings in white metal were made in the presence of the visitors.

The feature of the evening was to have been an illumination by Bengal lights of the famous Münster or Cathedral of Strassburg, and illuminations of the face of the old Castle on the River Ill. But the enjoyment of these was marred by heavy rain.

Exhibitions.

At the opening of proceedings on Thursday morning, Herr Lempelius, the Manager of the Central Gas Propaganda Organization, of Berlin, made a lengthy statement on the gas exhibition which it is intended shall be held at Munich next year. He said that it had become clear, in the course of the work of the Publicity Organization, that gas exhibitions were imperatively necessary, in order to educate not merely the populace but also

their law-makers as to the scope of gas as a popular lighting and heating agent. Only recently a law had been promulgated for regulating trade in petroleum lamp oil, in the preamble of which it was stated that petroleum was a cheaper illuminant than gas. As a fact the very reverse was true; and the error perpetrated in this and similar instances must be corrected by an active gas propaganda, which would reach those who drafted and passed the laws. There were 75,000 persons engaged in the gas industry in Germany, and coal to the value of 8 million pounds sterling was consumed annually in that country for gas making. After referring to the advantages which Munich presented for the holding of a great gas exhibition, the speaker proceeded to describe the scheme for it. This provided for demonstrations of the technical development of the manufacture and use of gas, and the ways in which it appealed to the people for adoption. A feature would be made of the utility of distributing gas from towns to outlying districts, and instruction would be offered through the medium of a scientific section, with laboratory and reading room. There was good assurance that the exhibition would be well supported by the people of Munich, and the Town Council had promised active collaboration in the scheme. The President of the Munich Chamber of Commerce, Herr Pschorr, had consented to act as Chairman of the exhibition. After Herr Lempelius had spoken, Herr Panzer, of the Corporation of Munich, stated that that body would do everything possible to ensure the success of the exhibition.

Herr Reinhardt, the Manager of the Corporation gas-works at Leipzig, drew attention to an organized visit of members of the Association to the Building Exhibition, now open in that city, which is being arranged for Sept. 26. The President reminded the members that a party was being formed for an inspection on Saturday (June 28) of the Instructional and Experimental Works of the Association at Carlsruhe.

Modern Boilers and the Heating of Retort-Settings.

The presentation of technical communications was then resumed. Herr Göhrum, the Manager of the Stuttgart Gas-Works, read a paper on "Modern Boiler Systems," of which several illustrations were thrown on the screen. An abstract-translation of this paper will be given in the "JOURNAL" next week. The next paper was by Dr. Karl Bunte, the son of Professor H. Bunte and General Secretary of the Association, on the "Technical Development of the Heating of Gas-Making Settings." This paper reviewed the construction of different types of retort-settings, with special reference to the shape and design of furnace chambers, the manner in which heat was produced and developed in them, and the methods of recuperation. It dealt with horizontal and inclined retort-settings, both intermittent and continuous vertical retorts, and oven or large-chamber settings. It is impossible to summarize briefly the ground covered by this paper. It gives a record of the different constructions, and draws attention to their special features, but does not express any very definite views as to the correctness or otherwise of them, or as to the lines on which development should proceed. An abstract-translation of the paper will be given in next week's "JOURNAL." In the course of the discussion on it, Dr. Strache, of Vienna, referred to a new type of plant for the continuous carbonization of coal and production of water gas *in situ* from the resultant coke. This plant had been under trial at Bergedorf for a year past, and had worked very satisfactorily. Herr Vaigl, the Manager of the Pilsen Gas-Works, predicted that there was a great future for such plant in the co-operative working of gas and electricity works. The coal would be gasified, and some of the gas would be used directly as at present, while the rest would be consumed in gas-engines for the generation of electric power. Boilers and steam-engines, with their low efficiency, would thus be dispensed with.

The Industrial Applications of Gas.

The next paper was one by Herr Albrecht, of Berlin, on the "Gas-Fire for Industrial Purposes." The author stated that the industrial use of gas depended not so much on its direct economy, but on the circumstance that heating by gas could be exactly regulated, that gas was ready for use the instant it was required without preparation, and that it did not cause smoke, soot, or dust. Its range of applicability and control was greater than that of the coal-fire. But its use could be greatly extended in the future, if it were supplied generally at considerably reduced prices for industrial heating. By way of showing what was at present being done in this direction in Germany, he had compiled an exhaustive statement of the rates at which gas was supplied for various uses in all the more important places. Some notes on this statement will be given in a subsequent number. The author showed by pictures on the screen various recent applications of gas industrially—among others, for disinfecting purposes. He believed that gas might be employed to a much larger extent for autogenous soldering or welding, and that this use would more than recover any loss due to the displacement of gas-engines by electro-motors.

Reports of Technical Committees and Private Business.

The reports of the various Technical Committees of the Association were next presented by their respective Chairmen, and approved by the meeting. Abstract translations of these reports are given on pp. 42-4 of to-day's "JOURNAL." The Report of the Council of the Association, of which a summary is also given on another page, was adopted. Herr Reese, the Manager of the Dortmund Water-Works, was re-elected President of the Association for the ensuing year, and Dortmund was chosen as the place for next year's meeting. The members of the Technical Committees were nominated; and the necessary grants voted for the continuance of their work. Herr Lempelius was elected as a new Vice-President of the Association. The President then thanked the Corporation of Strassburg, the Compagnie l'Union du Gaz, the Local Committee (of which Dr. Leoni was the Chairman), Herr Ruhland, the Manager of the Gas-Works, and the readers of papers for the way in which they had all contributed to the success of the meeting. The sitting closed with a vote of thanks to the President, Herr Reese, proposed by Herr Kordt, of Düsseldorf.

The Official Banquet.

The customary banquet took place on Thursday evening, in the principal restaurant of the Orangerie, where the inaugural assembly had been held. The toast of "The Kaiser" was given by the President, and that of the "City of Strassburg" by Herr Hase, of Lübeck. The Burgomaster, Dr. Schwander, responded to the latter. Herr Lempelius proposed the toast of the "Local Committee," coupled with the name of Herr Ruhland, the Manager of the Gas-Works, and Dr. Karl Bunte gave "The Ladies." Professor H. Strache, of Vienna, speaking on behalf of visitors, proposed the toast of "The German Association," and Herr Prenger, of Cologne, responded in a speech in praise of sympathy and co-operation among technical men of different nationalities.

A display of fireworks was witnessed from the terrace of the restaurant, followed by illuminations of the lake and grounds.

Excursions.

A special train at an early hour on Friday conveyed the members to the starting points for three different driving and walking excursions in the Vosges, for which three groups had been formed. They re-united in the evening for return by special train at a late hour to Strassburg. Unfortunately, the day proved rather cold and rainy. On Saturday morning, a party left for Carlsruhe, where the Instructional and Experimental Works of the Association were inspected under the guidance of Dr. Bunte and other members of their staff.

THE EIGHTH EDITION OF THE "HANDBOOK."*

THE progress of the gas industry and the appearance of successive editions of this popular "Handbook" go hand in hand. The vigour with which the technics of the industry are tackled is responsible for both. To the junior members of the gas profession is due to a large extent credit for much of the prosperity that may be recorded to-day. With the juniors, Newbigging's "Handbook" is an institution. There is no doubt at all that this publication has been, and will continue to be, an educational asset of great value to the gas industry. The early training of hundreds of the gas engineers of to-day and to-morrow has been a mixture of works routine, the reading of the Technical Press, and "Newbigging." It was so with the reviewer; and he returns to the eighth edition with affection and gratitude.

The volume with which most of us are so familiar is termed a "Handbook." The writer not being aware of an exact definition of this word, referred to a dictionary for the information. He was greeted with the fact that a "handbook" is a "manual." A "manual," however, was found to be a "handbook"—or a handy compendium. This appeared more promising. A "compendium" is an "abridgment" or "summary," which definition affords an explanation for the technical man, who is apt to be disappointed that the work under review appears to be unduly brief where he would wish it to be more complete. The writer, indeed, was, first of all, inclined to be critical of the brevity with which the author treated of subjects of importance. It was this first impression which led him to consult a dictionary as to the precise meaning of the word "Handbook." It is, therefore, unfair to condemn the author for summarizing, as it is shown to be the object of a "Handbook" so to do.

The work covers such a wide range that it is difficult to conceive by what means the author could do otherwise than summarize. It must be remembered that the subject-matter extends from "Coals" to "Burners." The only alternative would be to increase its size; but as it already contains 578 pages of text and index (and 67 pages of advertising matter), it would seem to be inadvisable to extend the volume in this direction. The size of the page is also quite large enough already. Subject-matter treating of manufacturing plant accounts for 240 pages. The following 110 pages deal with distribution practice. Then follow some 60 pages dealing, for the most part, with works testing methods. A small amount of space is next devoted to further district matters, to be again succeeded by "Residual Products." In this respect there appears to be a lack of proper arrangement. Everything dealing with the works proper should follow on in regular sequence; and in this connection, there is no doubt that testing methods such as—to give merely the headings—"Coal Gas Testing Appliances and Methods," "Tests for Impurities," "Illuminating

* "Handbook for Gas Engineers and Managers." By Thomas Newbigging, D.Sc., M.Inst.C.E. Eighth Edition. London: Walter King; 1913.

Power," "Jet Photometers," &c., should be included in the part of the book devoted to manufacturing details. The same criticism applies to "Residual Products."

It is, too, a matter of opinion whether the final hundred pages are wisely applied to a comprehensive collection of tables, memoranda, weights and measures, &c., required for reference by gas engineers. Some years ago the inclusion of such matter was undoubtedly of great value; but nowadays there are a number of publications solely devoted to such details, and it appears to the writer to be an unnecessary waste of space, which could better have been applied to a more detailed account of modern methods. For instance, is not the important subject of vertical retorts which have now been adopted in scores of large works, worthy of more than three pages? Even these few pages attempt to describe three different systems—namely, the Dessau, Woodall-Duckham, and the Glover-West. There is here a complete loss of the sense of relative importance of the various matters with which a gas engineer must be familiar. The few pages devoted to the "lime-burning" process are now of little more than academic interest, owing to the almost universal use of oxide of iron for purification purposes, and it is doubtful whether nowadays any gas engineer has to number this process among one of his multitudinous duties.

The chief changes in the book relate to, among other things, the description of the various machines now used for working horizontal retorts, and which are included for the first time. Additional washer-scrubbers are described. High-pressure distribution methods are dealt with in some detail, together with the description of a group of up-to-date lamps. A number of additional testing appliances are included for the first time. The text has been revised fairly extensively, and much obsolete matter deleted, to be replaced by descriptions of modern methods. The illustrations of the retort mouthpieces, being as they are of an obsolete type, are not pleasing. The author states—and rightly—that "radiation from the benches is reduced, and fuel economized to an extent greater than might be supposed, by temporarily bricking-up the furnace doors and the mouths of all retorts in beds not in use in proximity to others in action." Some mention might have been made of the great benefits, both in economy of fuel consumption and in the increased comfort of the workmen, derived from covering the front walls and tops of retort-settings with non-conducting composition. This practice is now the settled policy in a great many works.

The author mentions several remedies for stopped pipes; but the greatest of all is omitted. In this connection, heavy charges—preferably of twelve hours' duration, and not less than eight hours—have been found to be an efficacious cure. The whole subject of heavy charges is ignored, which is really regrettable, having regard to the vast improvement resulting from this now widely-adopted practice.

There is one paragraph under the heading of "Naphthalene" which caught the writer's eye. It refers to M. Brémond's method of drying gas, which, he claims, has the effect of arresting the aqueous vapour, as well as the excess of naphthalene, in the gas. The result of this treatment on coal gas was to increase the illuminating power to a considerable extent. The method of drying was to pass the gas through a vessel containing lumps of unslaked lime. Though naphthalene troubles have been, in most works and districts, cured by one or other of the many recognized methods, much worry to the consumer would be saved were the gas freed of its moisture before leaving the works. Bobbing lights are a fruitful source of annoyance in some districts, and can only result in decreased consumption and in expense in freeing the pipe of water. The question might with advantage be investigated.

It is noticed that the famous "Golden Rules for Gas Managers" have been altered. The third of the four "Rules"—"Keep down the pressure in the mains"—has been replaced by "Keep down the leakage or unaccounted-for." In the last edition (seventh) Mr. Newbigging replied scornfully to his critics of the third rule in a paragraph, explaining that whatever pressure was required either by day or by night must be maintained. There is no doubt, however, that the rule was read much too literally, and might with advantage have been worded differently—such as: "Maintain a sufficient pressure only in the mains."

The numerous recipes, chiefly for jointing purposes, mentioned by the author are most helpful, and constitute quite a feature of this popular vade-mecum of the gas manager. The subject of "Gasholder Construction" is especially well treated—there is no abridgment here.

The illustrations are numerous and (as usual) excellent. The index in the case of the work under review, unlike some that have come under the writer's notice, is quite adequate, and there is no difficulty in making references on any subject treated by the author. The chapters are divided for the most part into sub-headings, which method lends itself to a good index and ease of reference.

The general impression given to the reviewer is that some of the most up-to-date methods do not meet with sufficient attention. In some parts, moreover, it is noticed that too much space is devoted to old-fashioned ways and too little to modern ideas. Be that as it may, there are so many good points in this well-known work that the writer has no hesitation in stating with emphasis that every gas engineer and manager, and every technical assistant (whether he be experienced in his work, or whether he be a student in his first year of training), should be in possession of a copy of Newbigging's "Handbook."

INSPECTION OF FACTORIES AND WORKSHOPS.

Chief Inspector's Annual Report.

THE Annual Report of the Chief Inspector of Factories and Workshops (Sir B. Arthur Whitelegge, M.D.) was issued last week. It is followed, as usual, by a number of sectional reports (a summary of the contents of which is given) and by the reports of the Medical Inspector (Dr. T. M. Legge) and the Electrical Inspector (Mr. G. Scott Ram), all of which contain matter of interest to "JOURNAL" readers. There is a special report on the "Artificial Lighting of Iron Foundries," by Mr. D. R. Wilson, giving the tabulated results of some important investigations carried out by him; and this will be found elsewhere, p. 47.

The Chief Inspector deals first with legislation, and says there was no new legislation directly affecting the Factory Department during the year 1912; but the South Suburban Gas Act of that year requires that power gas shall have a "distinctive and readily perceptible smell" and shall conform to such further regulations (for safety) as the Secretary of State may make. The enforcement of these requirements, so far as concerns factories and workshops, rests with the department. There are now fifteen similar Acts in force; but under only one has power gas actually been supplied. In that instance notices were issued to all users; and, so far, no case of carbonic oxide poisoning has been reported. In the last report it was noted that the public inquiry held in October, 1911, on the objections to the draft regulations for the manufacture of patent fuel (briquettes), was, on the recommendation of the Commissioner, adjourned for a year in order to give manufacturers and workmen the opportunity of carrying out experiments, particularly with regard to the provision and use of baths and lavatories, overalls and goggles, and the suppression of dust. These experiments were carried out; and the inquiry was resumed at Swansea on March 11. Early this year, a Departmental Committee was appointed "to inquire and report as to the conditions necessary for the adequate and suitable lighting (natural and artificial) of factories and workshops, having regard to the nature of the work carried on, the protection of the eyesight of persons employed, and the various forms of illumination." Reference is made to the investigation by Mr. A. G. Drury, M.Inst.C.E., into the circumstances attending the gasholder disaster at Ilkeston on Jan. 8, 1912, and to his report thereon; also to the report by Mr. Wilson on the lighting of iron foundries already mentioned.

In the summaries of the sectional reports there is a table which shows that the total number of factories and workshops under inspection last year was 298,077; being an addition of 26,364, or 9 per cent.; but as 21,530, or 7·3 per cent., were removed from the register, the net increase was 4834, or 1·6 per cent. Abstracts and other papers were issued from the central office to new occupiers of 429 textile factories, 8645 non-textile factories, 20,555 workshops, and 510 other premises—making 30,139 in all. The total number of statutory notices and reports received by the Inspectors was 505,642, including 157,789 notices of accidents and "dangerous occurrences," 216,360 overtime reports, and 10,195 humidity records. The Inspectors forwarded to district councils 8228 formal representations with regard to sanitary and other matters, and 15,468 notices of occupation of workshops; the corresponding figures for 1911 being 7881 and 17,010. In addition to other written instructions and correspondence, 160,358 notices of contravention of the Acts were sent to occupiers, compared with 167,603 in 1911. The total number of effective visits to premises under the Acts was 404,722, of which 44,042 were outside the ordinary hours for protected persons. In all, 235,231 such premises were inspected during the year—177,335 once only, and 57,896 more than once.

EXTRACTS FROM THE SUMMARIES OF THE SECTIONAL REPORTS.

Lighting.—Lighting in the past has not, perhaps, received all the attention it deserves; but it is rapidly becoming a more prominent question. It offers many technical difficulties; and it is hoped that the recently appointed Departmental Committee already referred to may be able to make recommendations, based on scientific principles, which will benefit both employers and employees. The design of the modern factory is, in itself, proof that employers recognize the economic value of good lighting; but there seems to be lack of knowledge of the general principles on which efficient lighting should be carried out. Apart from the inquiry undertaken by Mr. D. R. Wilson the subject has received the attention of other Inspectors; and Mr. Shinner (Bristol) has been urging the use of frosted globes and the better placing of electric lamps in printing works, with the object of reducing "glare." Mr. Seymour (Leicester) and Mr. Bennett (Derry) refer to the introduction, with satisfactory results, of mercury vapour lamps in different factories; the latter remarking that this light is said to be softer to the eyes, and that in consequence complaints of headaches are less frequent among the workers. Bad lighting is reported in the Potteries in the Southampton district, in certain parts of ships in the Clyde shipbuilding yards, and in the scutch mills in the North of Ireland. It is considered that some of the fatal accidents caused by locomotives in the Cardiff district were probably due to want of proper lighting.

Boilers and Other Steam Vessels.—The requirements as to the examination of steam-boilers are well carried out, and cases of

neglect are becoming rarer; but Inspectors still sometimes have difficulty in deciding as to the competency of the person who makes the examination. Mr. Sydney Smith (the Inspector for Dangerous Trades) gives comparative tables for the last three years of boilers and other steam vessels at which explosions occurred. He instances three cases of explosion due to neglect to take reasonable precautions, and analyses the causes of explosions in certain other steam receivers. Mr. J. H. Warren completed an inquiry as to the conditions under which the cleaning of boilers and boiler flues is carried on; and his report appears as an appendix to that of Mr. Smith.

Carbonic Oxide Poisoning.—Some serious cases of carbonic oxide poisoning occurred last year, and, as is often the case, the original disaster was increased by the gallant rescuers themselves being overcome and losing their lives in attempts to save their comrades. A typical case is quoted from Barrow, where the victims were overcome in the flues which conveyed the waste gas from the blast-furnaces in an iron-mill to the boilers and gas-engines. Mention should also be made of similar gallantry in the Stockton district, where two men lost their lives in trying to save a comrade who had been overcome in a tar-still; and also of a second disaster which, like the Barrow case, occurred to men engaged in cleaning out gas-mains. Further cases in connection with suction-gas engines indicate the necessity for careful installation; and Inspectors are urging the provision of rescue and resuscitating appliances in all cases where danger arises. Dr. Legge supplies a return of reported cases of poisoning, and analyses them under various sub-headings. He also deals with other poisonous fumes, and with the dangers belonging thereto.

Electricity.—The Electrical Inspector (Mr. G. Scott Ram) deals very fully with this subject. He supplies the usual table of accidents in electric generating stations and sub-stations, and in other factories, and enters into some analysis of their cause. Electrical accidents are slightly fewer in supply stations, but slightly higher in other generating stations. The number in factories has decreased in spite of the great increase in the use of electricity. After an interval of several years, in which there has been no serious fire in public generating stations, three were recorded last year; and details are given of the causes that led to the outbreak. The chief points to be observed in connection with them are that in all three cases it was the covering of the cables that burnt and spread the fire; and though some of the cables were in fireproof tubes, these appear to have been of little use in checking the fire. Mr. Ram points out that the crowding together of cables should be avoided where practicable, so as to prevent an outbreak involving the whole premises; and he indicates other precautions against fire which appear to be desirable. There has been a great advance in the design of high-tension switchboards. But the same attention has not been given to direct-current medium boards, which are commonly arranged so that it is impossible to work on them without danger of making a short-circuit; and Mr. Ram indicates improvements that are desirable.

The Medical Inspector's Report.

The report of Dr. Legge contains, under the heading of "Fumes and Gases," a table giving some indication of the relative frequency with which cases of gassing are reported. The following figures refer to carbon monoxide: Blast-furnace gas, 33 (5); power gas—suction, producer, Mond, and Dowson, 19 (4); coal gas, 29 (2); other gases, 10 (3). [The figures in parentheses are those of the fatal cases]. Referring to the figures, Dr. Legge points out that blast-furnace gas contains about 35 per cent. of carbonic oxide, Dowson and suction gas about 25 per cent., water gas about 45 per cent., and coal gas about 8 per cent. He then goes on to say that formerly, when work was carried out in blast-furnaces with open top, workers engaged in charging used very frequently to be overcome. Now, owing to the richness of blast-furnace gas in carbonic oxide gas, with its high heating capacity, it is always conducted away in pipes and utilized, after subjection to a purifying process, to heat the blast, fire the boilers, or drive the engine. Charging is now done mechanically by means of an improved bell, during which time the workers retire to a safe distance. Among the 33 cases, with five deaths, reported from blast-furnace gas, 11 occurred in charging at the cupola or in repair work at the top of the gantry staging, five in repair work, ten (including four rescuers), of which four proved fatal, including flues, generally from the inside, two in an attempt to close valves thrown open by an explosion, and one was a worker overcome (while seated in a cabin) by escape of gas from a leaky pipe. Of the 19 cases of accidents with power gas, one occurred in starting the suction-gas engine, one from fumes of the vent-pipe carried to the outside air re-entering a workroom, two from escape of gas or exhaust gases into the engine-room, two (both fatal) in charging the producer for firing gas-works retorts, one in bricklaying, and eleven in repairing and cleaning operations.

In regard to coal gas, of the 29 cases, ten were definitely reported as having occurred in gas-works—one (fatal from cerebral hæmorrhage, the workman being only 24 years old) in cleaning an ascension-pipe, two (one fatal) in repairing cracks in the retorts, one in drawing a gas-retort, two in emptying the purifiers, and five in repairing mains or flues. Eight women weavers were overcome temporarily from escape from the gaslight fittings in a shed. Three of the cases were caused by a fragment of a broken skylight falling on and turning the lever-key of the supply-pipe. Nine cases were due to the discharge of exhaust gases from a gas-engine into the workroom. In both sets of cases, town gas supplying the engines was mixed with water gas. Two cases (one fatal) occurred in disconnecting a pipe at the top of a benzol scrubber without previously shutting off the supply.

Of the ten cases of poisoning by carbon monoxide from other sources, two occurred in repairing or filling cement kilns, and four repairing a tar-still in a coke-oven for bye-products recovery.

Dr. Legge refers to an investigation of the pathogenic properties of the gases discharged by the exhaust-pipe of gas-engines carried out by Professor Sheridan Delépine, following on two fatal cases of carbon monoxide poisoning attributed to the discharge into a culvert of gases from the exhaust-pipe of an engine at some distance from the place where men were working. When the coal-gas engine is working normally, there does not appear to be much probability that poisonous gases are produced in such quantities as to render a moderate amount of air mixed with them highly dangerous. Where there is imperfect combustion, however, he says "some highly poisonous gases may be produced, and among them carbon monoxide appears to be the most dangerous; others being acetylene, bisulphide of carbon, sulphuretted hydrogen, sulphohydrocarbons, and sulphocyanogens." The following are the Professor's conclusions:

1.—That the main cause of danger when my experimental engine was overloaded was the considerable reduction in the amount of oxygen contained in the exhaust gas. The proportion of carbon dioxide was also very large. The danger began to be rapidly manifest when the quantity of exhaust gas exceeded 50 per cent.

2.—That the main cause of danger when the supply of air to my experimental gas-engine was insufficient was the presence in the exhaust gas of a large amount of carbon monoxide. This danger began to be manifest when the proportion of exhaust gas reached one part of gas to forty or fifty parts of air. The carbon monoxide in the exhaust gas is partly derived from the unburnt coal gas and partly from the imperfect combustion of the gas that is utilized. It is probable, therefore, that the use of power gas is attended with greater danger than the use of ordinary light gas. Anything blocking slightly the entrance of the air-pipe is sufficient to bring about this danger.

Six cases of poisoning by sulphuretted hydrogen occurred last year—two in cleaning out a tar-still, and one from entering a still to recover the manhole lid which had fallen in. Another case occurred at a sulphate of ammonia plant, and was caused by an escape of the gas on restarting the pump for drawing off the condensed liquor.

Pitch Ulceration.

Towards the close of his report, Dr. Legge refers to the subject of pitch ulceration, and says:

Dr. H. C. Ross has widened considerably his experiments in connection with this subject. From Mr. W. J. A. Butterfield, F.C.S., the Secretary of the Metropolitan Gas Referees, he received a number of samples of different kinds of pitch, coal-tar fractions distilling at different temperatures, and from them he concluded that the dangerous principles are contained in the heavy oils of the coal tar. They cannot be distilled out completely without ruining the pitch; but it would be well if distillation were carried to the utmost point compatible with producing serviceable pitch. The dangerous principles are not anthracene or anthracene oil, but are probably some substances intimately mixed with them which distil over at the same temperatures. What they are we do not know. Dr. Ross, after experiment, does not consider acridine to be the cause of the trouble. For the purpose, however, of ridding the tar of the noxious ingredients, washing the tar, if the works concerned can undertake it, offered, so far as he could see, much the most satisfactory solution of the difficulty. Tar distillers, unfortunately, represent that water is their greatest enemy, and if so treated processes of distillation would become dangerous from frothing of the tar in the stills, as the only means of separation would be by distillation. In later investigations with numerous samples of coal, Dr. Ross has found both auxetic and kinetic properties present in bituminous samples, but in no case to anything like the degree they are in pitch or tar.

Dr. Legge adds, in this connection, that progress has been made in the South Wales patent-fuel works, following on the Commissioner's recommendations (to which reference was made in the last annual report). Washing accommodation has been provided, and suitable use made of it in some of the works. Elevators for the mixture of pitch and coal have been encased, and attempts made to relieve, by the use of lotions and ointments, irritation caused to the skin. The public inquiry will be resumed this year. Cases of similar epitheliomatous ulceration were reported during the year from tar-works.

Reducing Excessive Pressure in Purifiers.—Writing on this subject in the "American Gas Institute News" for last month, Mr. A. S. B. Little, of Nashville (Tenn.) said: "In a gas-works recently, trouble was noticed from back-pressure between the rotary scrubber and the holder. By the process of elimination, it was traced to the purifiers. Pressure-gauges showed that the two top layers of oxide were causing very little back-pressure. At gauges half-way up, and above the bottom layer, there was little loss in pressure shown; but from under the trays to the middle of the bottom layer excessive pressure loss was encountered. Mr. Pfeiffer, the Superintendent of the Nashville Gas-Works, knew it was not due to tar, and did not think it was due to oxide caking; but, in view of the fact that naphthalene was generally found in excess in this purifier, he decided to try and overcome the pressure by steaming-out the naphthalene. Free steam was introduced under the grids, and the back-pressure was very materially reduced."

HYGIENIC AND HEATING EFFICIENCIES OF GAS-FIRES.

By Thomas Glover, of Messrs. R. & A. Main, Ltd.

When the controversy on the above subject lately arose between Mr. H. James Yates and the Davis Gas-Stove Company, Limited, we undertook, for our own satisfaction, some tests to confirm or to disprove the statements put forward by both parties. Since the tests published by the rival firms, and the arguments set forth, have invited criticism from many and wide sources, we think that the publication of our tests may prove of some value to persons interested.

We were extremely interested in the letter from Messrs. Wilsons and Mathiesons, Limited, as published in the "Journal" dated June 17. We are able, in this instance, to corroborate the claims they put forward, and we wish here to enter our protest against the manner in which endeavours are constantly made to claim, as original, improvements which have already been introduced. In their letter, they go over most of the details of the construction of their fire; but they omit to mention the interesting point that they leave little "space between the front edge of the canopy and the refractory mantles." Yet all our tests have so far shown that neither in radiant efficiency nor in ventilating efficiency is their fire inferior to that of Messrs. John Wright and Co. We would suggest that this detail is one worthy of further investigation. The reason for this is, we believe, due to the distance between the lower edge of the canopy and the flue nozzle—a point already indicated by the Davis Company. Along with Messrs. Wilsons and Mathiesons, we congratulate the Davis Company upon the very frank and fair way in which they have carried on the controversy. We are sure that if statements which are made from time to time were subjected to similar treatment, nothing but good could possibly accrue to the gas-fire industry.

Regarding this matter, and also as to whether the air should be drawn from the room entirely through the flue nozzle of the fire, we can only state that our position is still that enunciated in an article published in the "Journal" on Jan. 23, 1912. We cannot do better than give the following extracts:

> "Abnormally projecting canopies are another endeavour to collect these products; and it can be laid down as a rule that the more the fuel projects from the body of the fire, and the greater the gap between the top of the fuel and the canopy the greater will be the proportion of products sent into the room. And, as indicated in the article, it is therefore necessary to let the canopy project in front of the perpendicular drawn through the centres of the burner nozzles. . . . *The argument that, to ventilate a room it is necessary to draw a considerable volume of air through the flue of a gas-fire, and consequently over the radiating material—whether the fuel or the brick—is unsound.* Ample air can be extracted from a room using the gas-fire as the means of warming the chimney; but instead of conducting the air through the canopy of the gas-fire, it is very much preferable to stand the fire so that there is a space between the fire and the mantel opening, to allow a considerable amount of air, over a large surface, and at a low rate of flow, to be drawn up the chimney behind the fire, instead of through the canopy. It is, therefore, possible with long fuel to have an extended area available for radiation without cooling-down the fuel or brick."

Criticism of the "Shadowgraph" Test.

We have admired the "Shadowgraph" method of testing the "hygienic efficiency" of gas-fires. Some two years ago we tried testing gas-fires by throwing a beam of light from a lantern across the canopy of a gas-fire, and watching upon a screen the effect of the varying density of the gases. We did not, however, proceed to elaborate the test, because we found that a simple test with a "Haldane CO_2 Apparatus," taking samples from points along the canopy edge, was a more reliable method. While the introduction of a cooled glass plate by the Davis Company certainly enhances the practical value and spectacular effect of the test, we must point out that, as described by them, it only serves to detect the products issuing at the middle point (or in close proximity to this point) of the canopy. Even when a deposit is obtained, the test can give no definite information as to the amount of escape of products. Certainly when some deposit is secured upon the glass, products are escaping; and this we believe is all the test can show. We are not aware how the claim that the test is a simple one can be justified; and certainly no ordinary householder would relish the introduction of ice baths and optical lanterns for a test *in situ*.

Again, we cannot accept the statement by Mr. Butterfield that "the 'Shadowgraph' test appears to the writer to be inherently more trustworthy than other modes of testing for the escape of products of combustion in front of gas-fires." We have never yet experienced any difficulty when using the "Haldane CO_2 Apparatus," and we submit that the "Shadowgraph" test is by far the more empirical and untrustworthy method. However, when there is no one at hand to carry out a simple test with a Haldane apparatus, we recommend a modification of the "Shadowgraph" test which was brought to our notice by the Brentford Gas Company. The test consists in taking a rectangular sheet of ¼-inch plate glass, previously cooled in a cold water jacketted tank, polishing the glass with chamois leather, and holding it horizontally and tangentially in contact with the lower edge of the canopy. The plate can be held at a corner, or at the middle, or at any other point along the canopy, and any products escaping may cause a dimness, easily visible from above, on the highly polished surface of the glass. The effect is often transient, but if a dimness does result, products are escaping.

Tests with a "Hood."

The accuracy of the tests with a Haldane apparatus are supplemented in our laboratory by testing with a hood fitted over the canopy of the fire. This method was used by Mr. J. H. Brearley; and it was described in a paper read before the Institution of Gas Engineers in 1907. It was subsequently used in the tests which are now universally referred to as the "Glasgow Tests." In our case, the hood is made of tinned sheet-iron. It is funnel-shaped, having a rectangular section measuring 12 inches by 24 inches at the "mouth," and a height of 12 inches. The sample of air is taken from the apex. All products which escape from the canopy rise into this hood; and the figures obtained for the CO_2 content of the sample abstracted from the hood are reliable guides for the "hygienic efficiency" of the fire. The following are figures obtained with the two fires under consideration:—

Fire.	Feet of Flue Pipe, 3-inch Diameter.	CO_2 in Room Air. Parts per 10,000.	CO_2 in Hood. Parts per 10,000.	Increase in CO_2. Parts per 10,000.
Davis's "Apollo" . .	0	9·0	11·0	2·0
Wright's "Talisman" .	3	7·0	22·0	15·0

Determination of Flue Heat.

In the determination of CO_2 in the flue gases, Mr. E. W. Smith used the gravimetric method at Leeds. In a laboratory where analyses of several flue gases are to be accurately and rapidly determined, this method is open to the objection that it takes too long, as the sample to be exhausted from the flue is too great. Some years ago, we carried out exhaustive tests upon the relative merits of the gravimetric and the volumetric methods of determining carbon dioxide in the flue gases; and finally we adopted a modification of Pettenkofer's method, described in a letter to the "Chemical News" of April 29, 1910, by Mr. Raymond Ross, F.I.C., the Borough Analyst of Burnley, and his Assistant, Mr. Joseph Race, F.I.C. The method has proved rapid and accurate. By a combination of this method of analyzing the flue gases with our hemispherical radiometer method of determining the radiant heat [see Appendix], it is possible to completely test a gas-fire for heating efficiency in half-an-hour after the fire has attained steady conditions.

We agree with the Davis Company that the testing of gas-fires connected to an ordinary brick or stone chimney is not free from objections. Meteorological conditions are, unfortunately, not subject to the despot of the laboratory. It has always been our practice to test 10-inch fires for radiant heat when connected to about 12 feet of 3-inch diameter circular galvanized iron flue-pipe. It is conceivable that many gas engineers will consider the diameter of this flue pipe too small. The answer is that the flue, fitted to any ordinary 10-inch fire, generally takes away 1000 cubic feet of air per hour, in addition to the products of combustion. In the tests published below, the volume of air with only about 7 feet of flue attached is close on 1000 cubic feet. This flue pipe terminates at a point near the sloping roof of the laboratory, and higher up the roof, and about 8 feet on either side of the flue pipe, two large cowls are fitted. These cowls effectively keep the air of the room hygienic. The great advantage of this method of connecting a flue is that the draught in the flue can be closely reproduced; for it is almost entirely undisturbed by atmospheric conditions.

It has never been our practice to test a fire without some flue pipe attached. We have two reasons to advance for not doing so. In the first place, it is not easy, if not impossible, to obtain an accurate test of the flue heat without some flue attachment. The sample of flue gas which is exhausted must represent the average composition of the flue gas; otherwise the calculation is absolutely valueless. We contend that, unless a length of flue pipe is fitted, it is almost impossible to obtain a true average sample of the gas escaping by the flue nozzle. In addition to this, if no flue is fitted, even the most hygienic fire is affected by draught currents across the front of the canopy. The whole condition of the fire is unsteady. In the second place—and this is the more important reason—no fire is ever fitted into a room and permitted to throw all the products into the room. It is invariably fitted to some chimney or flue, either tightly or loosely. Consequently, the determinations of radiant heat and flue heat made upon a flueless fire are of little practical value.

Details of Actual Tests.

In the tests published below, each fire was fitted with an inclined reducing elbow having a total height, measured from the middle horizontal line of the flue nozzle casting, of 13 inches [see fig. 1]. The temperatures were read upon a thermometer placed at a point 10 inches from the above line, and having the bulb in the centre of the flue. Samples of the flue gas were abstracted from the centre of the flue, about ½ inch above the bulb of the thermometer. The particular fire under test was lit at 8 a.m.; and the gas consumption was carefully adjusted to 27 cubic feet

per hour when corrected to 30 inches mercury and 60° Fahr. Throughout the test, the gas consumption was maintained at this figure. The first test was made at 10 a.m., and a confirmatory test at 10.15 a.m. An additional piece of flue pipe, 12 inches long,

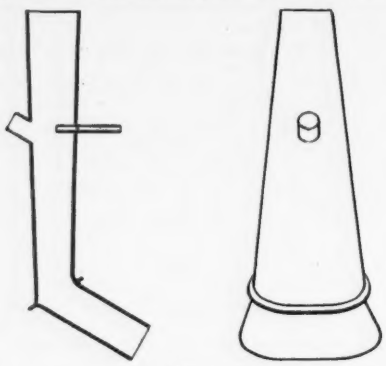


Fig. 1.

was then added; and a second test was made at 10.45 a.m.—a confirmatory test being made at 11 a.m. Again an additional piece was added to the flue, and the third test made at 11.30 a.m.—a confirmatory test being made 15 minutes later.

This sequence was repeated until tests with 80 inches of flue pipe had been added. Preliminary tests were carried out with both fires, to prove that all the apparatus used was accurate, and that the method was reliable. This was necessary—especially as we were doubtful whether half-an-hour was a sufficient length of time for the fire to assume steady conditions after an increase in the length of the flue. Each complete test, with seven different lengths of flue pipe, took about eight hours. Three accurate tests were carried out with each fire, and found to be practically identical. The results published are those obtained in the final test of the series with each fire. Tests of the calorific value of the coal gas were taken every half-hour with a Junkers calorimeter, and were found to vary, at the maximum, only 5 B.Th.U. on either side of the average given. Samples of the coal gas were also taken every half-hour, and exploded with oxygen in a Bone and Wheeler apparatus. The carbon dioxide in the room air was determined by means of the Haldane apparatus, and the humidity of the air by a Mason's hygrometer, standardized at the National Physical Laboratory, using Glaisher's tables. The constancy of the composition of the air shows the excellence of the room ventilation.

Inferences from Results Obtained.

An examination of the total room-heat curves shows that there is a decided break in the curve for the Wright fire, which is absent from that for the Davis fire [see Diagram I.]. A similar break

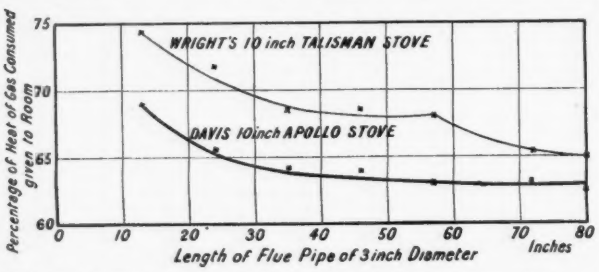


Diagram I.—Variation in Percentage of Heat of Gas Consumed, given to Rooms by Gas-Fires with Varying Lengths of 3-inch Diameter Circular Flue-Pipe attached.

will be noticed in the carbon dioxide curve for the Wright fire [see Diagram II.]. The increase of slope in the heat curve is, of

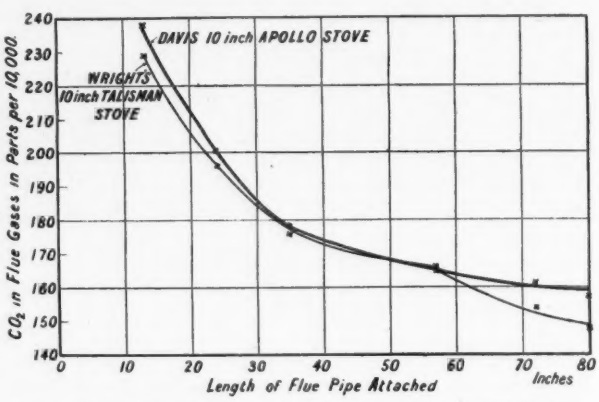


Diagram II.—Carbon Dioxide in the Flue Gases of Fires with Various Lengths of Circular 3-inch Diameter Flue-Pipe Attached.

course, due to the increase of slope in the carbon dioxide curve; for the former is calculated from the latter. To account for this break, we advance the following reason. The increase of draught caused by each successive length of flue pipe added to the Wright fire, not only drew additional air into the flue, but also drew in some of the products of combustion which escaped before the additional length was added. When, however, 57 inches of flue pipe had been added, the increase of draught caused by an additional length of flue pipe was expended entirely in drawing in more air; and consequently the rate of decrease of carbon dioxide, in parts per 10,000 of the flue gas, was accelerated. This accounts for the increased slope of the curve. The fact that there is no break in the carbon dioxide curve for the Davis fire shows that all the products were already in the flue when only 13 inches had been added.

The result of the radiant heat tests shows that there is practically no change in the radiant efficiency of the fire with increase in flue length up to 80 inches. Though there is a total increase in the flue heat of 9·4 per cent. in the case of the Wright fire, and of 6·4 per cent. in the case of the Davis fire, the loss is entirely at the expense of convected heat.

The unsatisfactory character of the calculation for the volume of air and amount of heat passing into the flue per hour—due to the fact that all the products are not passing into the flue, which the calculation assumes is the case—is one which requires further investigation. The volume varies inversely as the difference between the carbon dioxide content of the flue gas and that of the air. Consequently, if these latter figures are too small, the figures obtained for the volume of air passing into the flue are too great. We suggest that this is what has actually occurred in the case of the "Talisman" test, with the shorter lengths of flue pipe. Reference to Tables I. and II. will show that the volumes of air passing into the flues per hour with lengths of flue pipe up to 57 inches, are very close together. With 57 inches, the Davis fire is actually taking more air into the flue than is the Wright fire. These results lead us to expect that, if a correction could be applied for the escape of products of combustion, the Wright fire would not be taking more air into the flue than the Davis fire. When this fact is duly considered, along with the fact that the Davis fire is taking all the products away, the advantage of the Davis fire, fitted so as to avoid too excessive a pull on the flue nozzle, is obvious.

APPENDIX.

Our Method of Determining Radiant Heat of Gas-Fires.

The chief objection which we have always raised regarding the thermopile method adopted by the "Gas Heating Research Committee" appointed by the Institution of Gas Engineers, and

TABLE I.—Tests with the Davis 10-inch "Apollo" Gas-Fires, May 30, 1913.

A. Length of Flue Attached to Fire. B. Temperature of Flue Gases. C. Temperature of Room Air. D. Difference between Temperatures of Flue Gases and Room Air. E. Carbon Dioxide, in Parts per 10,000 of Flue Gases. F. Volume of Air Passing into Flue per Hour. G. Heat Passing into Flue per Hour. H. Percentage of Heat of Gas Consumed Passing into Flue. I. Total Percentage of Heat of Gas Given to Room. J. Percentage of Heat of Gas Given to Room as Radiant Heat.

A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
In.	° F.	° F.	° F.		Cub. Ft.	B.Th.U.			
13	430	75	355	238	519	4,030	31·1	68·9	48·0
24	404	77	327	201	647	4,455	34·4	65·6	47·8
35	377	78	299	178	758	4,659	36·0	64·0	47·5
46	373	79	294	172	772	4,658	36·0	64·0	47·3
57	363	81	282	165	834	4,779	36·9	63·1	47·5
72	357	82	275	161	861	4,792	37·0	63·0	47·6
80	354	83	271	157	889	4,853	37·5	62·5	47·3

Gas consumed per hour at 30 inches mercury and 60° Fahr. = 27 cubic feet.
Net calorific value of gas = 480 B.Th.U.
One cubic foot of coal gas gave ·57 cubic foot CO_2, 1·23 cubic feet water vapour, and required ·93 cubic foot of oxygen for combustion.
Humidity of air of room: 1 cubic foot contained 5 grains of water vapour.

TABLE II.—Test with the Wright 10-inch "Talisman" Gas-Fire, June 4, 1913.

A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
In.	° F.	° F.	° F.		Cub. Ft.	B.Th.U.			
13	359	70	289	229	543	3,324	25·6	74·4	56·2
24	347	71	276	196	665	3,786	28·2	71·8	56·0
35	336	72	264	176	761	4,075	31·4	68·6	56·0
46	330	73	257	172	784	4,068	31·4	68·6	55·8
57	325	73	252	166	818	4,144	31·9	68·1	55·4
72	323	74	249	154	896	4,448	34·6	65·4	55·6
80	317	74	243	148	913	4,540	35·0	65·0	55·5

Gas consumed per hour at 30 inches mercury and 60° Fahr. = 27·2 cubic feet.
Net calorific value of coal gas = 477 B.Th.U.
One cubic foot of coal gas gave ·57 cubic foot CO_2, 1·23 cubic feet water vapour, and required ·93 cubic foot of oxygen for combustion.
Humidity of air of room 1 cubic foot contained 5 grains of water vapour.

used by Mr. E. W. Smith, M.Sc., at Leeds University, is that too great a length of time is required to carry out a test of the radiant heat of a fire. In a works laboratory, where many modifications of a particular fire are to be tested before a pattern maker can be given instructions to proceed, the time-factor becomes of great importance. Some work was done by Mr. J. W. Clark with an instrument of the calorimetric type. In a paper which he read before the London and Southern District Junior Gas Association, he described the instrument; and the paper was published in the "JOURNAL" for April 26, 1910. Mr. Clark made determinations of the heat falling upon a flat tube placed at several points around a fire.

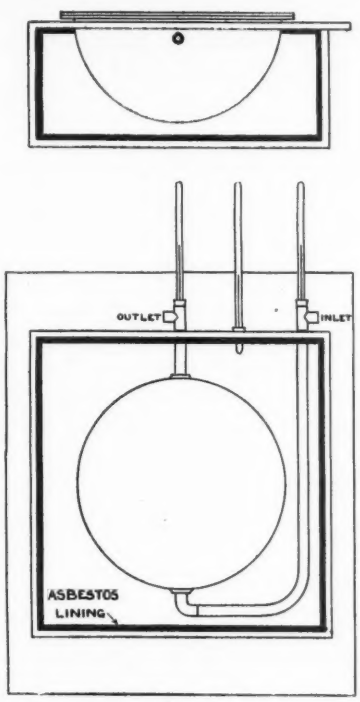


Fig. 2.

The method, while being simpler than the thermopile method, requires too many determinations to be taken when only the total radiant heat is required. Of course, when the radiant heat in a particular direction is to be determined, the thermopile method is undoubtedly the best. For total radiant heat tests, however, we designed an instrument which admits of a determination being made with the apparatus in one position only. The first model has now been in use in our laboratory for over two years. It has been seen by many gas engineers and chemists, who have been satisfied that it enables a rapid and accurate determination of the radiant heat of a fire to be made in a very short time. The instrument consists of a hemispherical body made from two copper hemispheres, having diameters of 18 inches and 18¼ inches respectively [see fig. 2]. We adopted this diameter for the first model of the instrument because it is our custom to test all modifications of our fires upon our 10-inch size in the first place. Both hemispheres have turned-over flanges which are bolted together, and carry the whole strain of the support and water connections—thus relieving the body of any strain. Suitable guides are placed between the copper hemispheres, to cause the water to flow evenly over the whole surface of the hemisphere. The concave side of the apparatus, which is directed towards the fire, is painted dead-black; the convex side being very highly polished. The inlet and outlet thermometers are placed on the same level, and close together. The whole apparatus between the two thermometers is enclosed in a wooden case of ample dimensions, lined with board asbestos, which forms a convenient support and minimizes radiant heat loss.

The first work undertaken with the instrument was to determine the ratio between the values given by the instrument and those given by the thermopile method. After an extended series of tests upon ten well-known 10-inch fires of various makes, and an equal number of modifications of our own 10-inch fires, we found that if C be the value given by the hemispherical radiometer, and E the value given by the thermopile method, and k a constant, then $E = k\ C$. The value of k varied from 1·28 to 1·32; this variation being probably due to faults in both methods. In all later work, therefore, where results were stated in terms of the thermopile method, we adopted the average figures for k, which was 1·3.

When carrying out these comparative tests, we made inquiries regarding the values for the radiant heat obtained by other experimentalists with calorimetric methods, and we were invariably informed that the results obtained were much lower than those secured with the thermopile method.

The ease and rapidity of working with the instrument are great advantages over other methods. There are no great precautions to be taken regarding "centering" the instrument with the radiant surface of the fire. Provided the middle vertical line of the radiometer is parallel with the middle vertical line of the fire, and in the plane at right angles to the radiant surface, a motion of the fire bodily up or down for an inch or so, or the slight tilt of the fire from the vertical, does not affect the accuracy of the determination.

We trust this short description of the instrument will be of interest to all who are engaged in the testing of gas-fires. It is, and always has been, a pleasure to us to show the instrument in detail to gas engineers visiting our laboratory, and invite their criticisms.

LARGE EXTENSIONS AT THE NATIONAL PHYSICAL LABORATORY.

The Right Hon. A. J. Balfour on the Relations of Industry and Science.

THE large extension scheme—comprising new laboratories for metallurgy and optics and office accommodation—at the National Physical Laboratories has been all but completed. There is more equipment work to be done; but it should not be long before this is accomplished. The scheme will cost, according to the estimates, £35,000; and it is hoped that the generosity of industries and of the public will provide the few thousands that have still to be raised.

The development of this centre of research and of general experimental work has been noticed from time to time in our columns; and there is no occasion to specially refer to it again excepting in one or two of its latest phases. The photometrical department is still much as it was. In the general engineering department the testing of road materials is among the new work undertaken; and in connection with this there is a complete equipment in the way of tools, pitch boilers, driers, &c., for the purpose of making up experimental roads. In the Wernher building is the department of metallurgy and metallurgical chemistry. The work here includes: (*a*) Metallurgical research and investigatory testing, involving the application of the microscope, the pyrometer, and of other physical and chemical methods to the study of metals. The investigatory testing deals chiefly with cases of failure occurring in practice which are referred to the laboratory and dealt with jointly by the metallurgy and engineering departments. The researches of the department are directed to the study of important groups of alloys (chiefly in connection with the Alloys Research Committee of the Institution of Mechanical Engineers) and to the elucidation of the structure and constitution of metals and alloys generally. (*b*) Chemical analysis of material for Government Departments. (*c*) Chemical analysis, principally of metals and alloys required in connection with the research work of this department and with the work of the laboratory generally. This work includes the preparation of pure substances, and the examination of new methods of analysis and allied problems. (*d*) Chemical work connected with aeronautics. The whole department is now housed in the new Wernher building and in the adjoining building containing the laboratories for metallurgical chemistry. The Wernher building consists of a double-storey block measuring approximately 50 ft. by 100 ft., with a workshop and foundry attached, while a single-storey wing connects with the chemical laboratories. The ground floor of the main block is principally devoted to the cutting, grinding, polishing, and etching of metal sections and their subsequent examination and photography by means of the microscope. The workshop is to be equipped with testing machines and some machine tools. The foundry provides ample space for handling metal in comparatively large quantities. A 3-ton travelling crane is provided. Gas-heated furnaces by Fletcher, Russell, and Co., and by the Richmond Gas-Stove Company are installed; and some fairly large castings have been made. A special moulding room is provided, and also a machinery room, in which an air-compressor serving the whole building is installed. The second floor of the main block contains the offices of the Superintendent and staff, and rooms devoted to small laboratory furnaces and to pyrometry. The delicate potentiometers are placed in a special room situated between those devoted to gas and electric furnaces. The electric furnace room contains the switch-board which controls a 450 ampère-hour storage battery situated in an adjoining room. Special furnaces for taking heating and cooling curves at any desired uniform rate are installed. The chemical laboratories, with the chemical wing of the Wernher building, now include special rooms devoted to the following branches of work: Steel analysis, alloy analysis, chemical work on cement and on road materials, chemical work connected with aeronautics, electrochemistry, gas analysis, and spontaneous combustion research. A dark room for chemical work, as well as balance-room and

offices, are also provided. The William Froude national tank has been established for the carrying out of systematic research work in connection with ship propulsion, and for testing ship models for private ship-builders and ship-owners.

Last Thursday afternoon the new buildings were opened by the Right. Hon. A. J. Balfour, P.C., F.R.S. A special train was run from Waterloo Station to Teddington; and as we passed from the latter station to the National Physical Laboratory, many men renowned in science and in the scientific work of our industries were observed. The visitors assembled in the building recently provided for the erection of a large air channel for aeronautics research. The chair was taken by Sir A. Geikie; and he was supported, in addition to Mr. Balfour and Colonel Seely, by Lord Rayleigh and many distinguished men in the realms of science. Noticed among others were Sir Oliver Lodge, Sir William Crookes, Sir Alfred Keogh (who was present at the Jubilee Dinner of the Institution of Gas Engineers a fortnight since), Sir John Brunner, Bart., M.P., Professor Unwin, and Dr. Frank Clowes. We are not sure whether Professor W. A. Bone, and Mr. Charles Carpenter, D.Sc., were present; but their names were in the list of intending visitors. Mr. H. E. Jones, Mr. Walter Hunter, and Mr. W. E. Price, the new Hon. Secretary of the Institution of Gas Engineers, were observed in the large audience.

Sir A. Geikie opened the proceedings, and referred to the National Physical Laboratory as one of the most important of the national institutions; and he also explained how largely the place and work have grown. Some explanatory statements concerning the new buildings and the work to be carried on in them were made by the Director, Dr. R. T. Glazebrook. Lord Rayleigh, on the other hand, hoped that this opening of the extension would be the means of placing in the hands of the authorities the necessary funds to complete the scheme. He also mentioned that it had been the hope of some of them that pure science might have figured more in the work of the laboratory. But the larger part of the work that had been done had been in close relation with standardization, and the research required for the actual technical and testing work. Perhaps, however, in the future, he remarked, the work might extend a little in the other direction. It was a question of funds; and it was not so easy a matter to ask the Treasury for funds for pure science as it was for funds to be devoted to the industries and arts. Then followed Mr. Balfour; and from his eloquent speech we extract some parts that particularly appeal to men in all industries.

Mr. Balfour remarked that the three previous speakers had given a very clear idea of the rapid growth of the institution, and had expressed a sanguine expectation that the growth in the past was a happy augury of its increase in size and utility in the time to come. Those who availed themselves of the advantage of inspecting what had been done and was in course of being done, would obtain from that experimental observation a far more vivid idea of the work and growth of the institution than any elaborate explanation from the platform could possibly give. Some there might be who might be disposed to ask why there should be a National Physical Laboratory at all. Why not leave the work done by the institution to be carried out by private enterprise? Why should contributions of the Treasury and the liberality of donors be given to carry out work which was clearly of vital interest to the whole of the manufacturing industries of the country, and those who depended, either as consumers or capitalists or employed, upon the success of those industries? Why was it not left to them to carry on the work done in these buildings? Another question that might be asked by some was this, Was there anything so very important in the work of standardizing and measuring which should require these vast sums of public money to be spent upon them, with the great expenditure of the highest scientific, mathematical, and technical skill such as was displayed by the staff of the laboratory? As to the second of these questions, he would say that measuring was of the very life blood of physical science. It lay at the root of most great discoveries; it lay at the root of application to practice. One of the great conditions of human progress was the growing command over Nature. And this growing command over Nature was a spur to their activities in which it was plainly and obviously certain that immense advances had been made during the last 150 years. The advance, instead of diminishing in its rate of progress, seemed to be increasing; and they were still moving in the right direction. Such measurements as were carried on in an institution like this were not only desirable, but also necessary to a great manufacturing country like this. If the country had allowed itself to neglect this work—theory and practice were so closely married—it would inevitably have fallen behind in the competition between different nations on which the growth of industry naturally depended. He came to the first question, Why could not this work be done by private individuals? Why could it not be done by the manufacturers themselves? A great deal was already done. Large manufactories spent immense sums both on an adequate staff and adequate machinery, by whom and by which large tests and measurements of all kinds were carried out. But an institution like this had an immense advantage over the manufacturer, in that it was impartial. Moreover, in some departments of industry it was necessary that there should be some place where manufacturers could come without favour, and get the use of a staff of the highest possible scientific acquirements, and instruments of the best possible construction. The advantage to industry must obviously be very great. Lord Rayleigh had expressed regret that, in the history of this institution, a large fraction of the labour had been devoted to matters immediately connected with industry more than to abstract investigations, or purely scientific investigations, on the success of which, as the years went on, industry depended. He (Mr. Balfour) thought that all must share in this regret. One of the foremost articles of his social faith was that it was to the labours of the men of science, working for purely scientific ends, without any thought of the practical application of their discoveries, that mankind would be most indebted. He should therefore desire that as much advance as possible in pure science should be made in this building as money and place would allow. He knew that this was right. But he was quite conscious that perhaps, through a certain lack of imagination, the general public did not quite realize the two separate propositions he had been advancing. They did not realize that it was to the results of pure science that the country owed in the past, and would owe still more in the future, the great advance in industrial knowledge and practice. He hoped these truths, which were really truths of great importance, would slowly and effectively sink into the public mind as time went on. There was one question he should like to ask; and it was whether, as a matter of fact, the elaborate instruments of measurement which had been installed in the institution for practical purposes did not cause some reaction upon science itself in a favourable direction; whether it did not give indirectly, if not directly, some help to those who were pursuing science for its own sake? If this had not happened, it would happen. Nothing could be more certain than that the action of theory upon practice, and the reaction of practice upon theory, had always been, and always would be, fruitful of the most admirable results. The growth of the institution during its few years' existence justified them in looking forward to a great and glorious future for it.

Concluding an address of which the foregoing is but an epitome, and that incomplete through the omission of several of the points, Mr. Balfour declared the new buildings open. Then, in suitable terms, Colonel Seely, Secretary of State for War, proposed a vote of thanks to Mr. Balfour. Afterwards a vote of thanks was moved by Sir John Brunner to Sir A. Geikie; and there was also acknowledgment of the work of Dr. Glazebrook and his staff. Following this an inspection of the buildings, plant, apparatus, and equipment generally was made—the whole staff being in attendance in their several departments to give information. Tea was served in the grounds; and so an exceedingly interesting visit came to an end.

COMPETITION FOR THE DOMESTIC COOKING BUSINESS.

The "Point Fives" and Cooking by Electricity.

For achieving success in the competition of electricity for domestic cooking and heating business, some of our electrical friends think is entirely a matter of the price per unit charged; there are no other factors that count with certain of them. It does not matter to them what qualitative value can be purchased for a given price. If 3420 B.Th.U. (or 3440 B.Th.U. as some electricians claim) can be purchased from electrical sources for 1d., then it matters not that 16,500 B.Th.U. can be purchased for the same coin from a large proportion of gas suppliers—in certain cases more, in certain others less. It matters not that first cost of electrical apparatus and installation expenses are more than in the case of the gas-cooker; and it matters not that the maintenance costs are also greater with the former than with the latter. It matters not that the electric-cooker cannot give, in points of time and economy for all the operations from boiling to baking, the same all-round efficiency as the gas-cooker. It is with certain of them only the question of the cost of energy consumed that matters. Therefore, the "Point Fives" Association have before them a great piece of missionary enterprise. They want to convert the managements of all electricity undertakings to the adoption of the "Norwich" method of charging so much on the rateable value of dwellings and a flat-rate of 0·5d. per unit for the energy consumed—the fixed charge on the rateable value being, as a rule, 12½ or 15 per cent. The average price per unit is not, therefore, anything like ½d.; so that the electricians cannot claim that the comparison is now reduced to the B.Th.U. that a unit of electricity is capable of producing, and the B.Th.U. that a halfpenny worth of gas is capable of generating, which would still be, at 2s. 6d. per 1000 cubic feet, approximately, 8250 B.Th.U., and at 1s. 3d. 16,500 B.Th.U. There is a point of policy about the fixed charge per dwelling, *plus* the ½d. per unit. The higher the consumption, the lower will be the average price paid per unit; and it is quite possible that the average might be brought down to a figure at which the consumer is not paying, on his intermittent use of current, his proportion of standing and other charges, which will be thrown back upon the consumer of current for lighting purposes only at a flat-rate, who prefers to use more economical heating energy obtained from another quarter.

A Low-Price Experience.

That the "Norwich" system, as already described, is not a cheap one for the purposes of heating and cooking, is seen by the indirect testimony conveyed in the address with which Mr. A. S. Blackman initiated a recent discussion at the meeting of the "Point Fives" Association. Be it remembered that to the ½d. falls to be added a proportion of the fixed charge. This is what Mr. Blackman says:

> With regard to the unit charge, we in Sunderland tried ¾d.; and, as the result of a good deal of activity, a number of consuming devices were sold, and put into use. The consumers were pleased with the comfort and convenience, but *the cost of using was so great* that we were faced with the alternative of either letting the apparatus fall into disuse, and of abandoning our cooking and heating development for the time being, or of materially reducing the unit price, which was accordingly brought down to ½d.

We are not told what has been the result of this lowering of price by one-third—from ¾d. to ½d.; but Mr. Blackman's statement only goes to prove that the selling of electrical energy for cooking and heating at several hundred per cent. below lighting rates is not altogether efficacious, and incidentally it shows the appreciation of the electrical people of the strength of gas in this field. It is, in fact, the greatest compliment the electricians could pay gas to acknowledge that such a cut-price is necessary for competition purposes—a price brought down by this extent before the gas people have even given a thought in most districts to allowing a discount on the cost of gas used for cooking and heating.

Is Price Per Unit the Dominant Factor?

Even such a close observer of things electrical as Mr. S. Z. de Ferranti is satisfied that above everything else the question of price of the supply of electricity is the one that is going most largely to settle the general usefulness and the general adoption of electricity for all purposes. Mr. Haydn Harrison, on the other hand, would have electricians believe that they are making far too much of this question of price; for if they charge 1½d. per unit for cooking, and gas undertakings only 1s. 9d. per 1000 cubic feet, electricity will win easily. Mr. Harrison bases this assertion on the experience in his own house, and thereby testifies to a shocking incompetence in his domestic kitchen arrangements. For 1½d. Mr. Harrison can, at 1s. 9d. per 1000 cubic feet, buy 71 cubic feet of gas; and at 500 B.Th.U. per cubic foot, Mr. Harrison's kitchen has 35,500 B.Th.U. at disposal for 1½d. But those under whose management the kitchen is, could not do more with this—so Mr. Harrison suggests by his declaration—than they can do with 3420 B.Th.U. electrically generated. Does Mr. Harrison genuinely believe that anyone, excepting himself, will give credence to this appalling condition of heat waste? It is extremely unfair for a man, especially one dealing in another line with the refinement of 0·05 foot-candle, to talk in this loose way. If he only knew what the gas-cooker was really made to do, compared with what his electric-cooker can do, or is called upon to do, there would be a different story to tell. We may inform Mr. Harrison, as he appears to be unconscious of the fact which is so very apparent to others, that he is not the only man in the British Isles with experience. Mr. Clinch, the proprietor of the Delico Restaurant (which if our recollection serves us right has, or had, some connection with a certain Delicacies Association to which Mr. A. H. Seabrook and the Marylebone Electricity Department gave their patronage), says that at 1½d. per unit electricity is certainly dearer than gas for cooking, but there is the same old looseness of assertion. Nothing is mentioned in the report as to the price of gas, or what the assertion covers in the way of apparatus, work, and time. But electricians who pride themselves on their precision in some things technical, are the most lamentable failures at explaining what they really mean in connection with this subject of cooking; and they applaud and foster looseness and excesses in statement in the commercial department. Further, as to Mr. Clinch's statements. He asserts (again no particulars are given) that at 1d. per unit for current, electric cooking costs about the same as gas; and at ½d., it is cheaper. But Mr. Clinch also made another point; and it is that electrical apparatus would not take the place of steam, because one cannot produce steam from electricity so cheaply as from coal. It follows that electricity cannot produce steam so cheaply as gas; so that there is a modicum of hope allowed the gas industry in even the "Point Five" circle.

Hiring-out and Hiring-out Rates.

But there are warnings. The Point Fives and their friends realize that the hiring-out of electric cookers is an important thing to encourage interest in electric cooking. But with the comparatively short life of electric appliances, and the merry and sometimes exciting time that they give to consumers, there is a difference of opinion as to who should be the hirers-out. Some electrical engineers think the manufacturers ought to take the matter in hand; while the manufacturers consider the electricity suppliers are the proper people—the apparatus being the means to the end (so the hope is indulged) of a good consumption of electricity. Mr. A. F. Berry (whose name appears familiar in connection with the "Tricity" cooker) entertains the view that the rate at which hiring-out is done is of more importance than the rate at which current is sold. That hiring-out is absolutely essential is the opinion of Mr. H. H. Holmes (of Borough of Marylebone fame); while Mr. R. Schofield (who is interested in the firm of Ferranti) thinks a price for current which includes hire is better than ½d. per unit. Mr. F. S. Grogan (also a "Tricity" man) is confident that, with a low hiring rate and a high price per unit, he would get out from five to ten electric-cookers to every one under a system having a high-hiring rate and a low price per unit. It is seen from these remarks that the manufacturers are on the one side anxious for a low hiring rate; while if the electricity suppliers are to do the hiring-out—already charging prices for energy that are not profitable for such an intermittent load—they are faced by the necessity of seeing that, in the hiring part of the business, they do not bring upon themselves a further financial burden. Note what Mr. Holmes says upon this point. "The figure as to hire in relation to net purchase price appears to be from 20 to 25 per cent., which I believe will eventually show the hire of electric-cookers to be at least a self-supporting proposition." That is to say, if an electric cooker costs the electricity suppliers £10, the consumer should pay £2 or £2 10s. hire per annum. This does not present a promising outlook, knowing what we do in the gas industry as to consumers' notions on the subject of hire payments, and getting things for next-to-nothing. The high figure named by Mr. Holmes also gives the consumer a lively sense of troubles to come, and of a short life of activity on the part of the electric-cooker. There is also a point in Mr. Holmes's remarks to which the attention of gas-stove manufacturers may be directed. He states that he knows of one or two cases in London recently where decision as to the adoption of electric cooking rested mainly on the first cost of the apparatus; and he finds that the first cost of complete electrical equipment for commercial purposes is actually less than the cost of a steam and gas cooking equipment. There again there is a careful exclusion of all particulars to show whether or not Mr. Holmes is dealing with conditions that have absolute equality in the matter of the respective apparatus. If there is equality, then there is no reason why a gas plant to do the same work should cost more initially than an electric one. The contrary is really the case. However, the point is one to which it is worth while drawing attention; and gas apparatus manufacturers will no doubt see to it that Mr. Holmes is not able to again make this boast—assuming that he is dealing with comparables.

Standardization.

There was not much said (according to the reported discussion) about the cooker standardization question, to which reference has been made recently in our "Electricity Supply Memoranda," excepting in regard to details. The manufacturers have set the "Point Fives" in proper position on this matter. The standardization of accessories is one thing; the stereotyping that was indicated when the "Point Fives" first mooted the question, is not to be tolerated. Mr. Schofield says that details which can be standardized are the maximum and minimum sizes to be allowed, but not the shape; the number of boiling-plates; provision for earthing; interchangeable units; switches on cooker or wall; and fuses for each circuit. The idea of the "Point Fives" is to secure greater reliability than now exists, at a greater manufacturing expense, and for the payment of less money for the appliances. The matter is not presented in quite such explicit terms; but the mode of presentation is very significant as to the meaning of the "Point Fives."

Radiant *v* Convected Heat in Cooking.

In his address, Mr. Blackman stated that the question as to whether radiant or convected heat was preferable for ovens, is one upon which considerable difference of opinion prevails. Some people are of opinion that radiant heat is better for meat and convected heat for bread; while others suggest that convected heat is better for all classes of work. He calls attention to the point because an oven that may be an "outstanding success" in the South of England, where people do not bake their bread, may be a failure in the North, where, speaking generally, they do. Mr. Berry says he finds that sometimes radiant and sometimes convected heat is required, and usually both sorts are needed. Then Mr. Grogan, of whose scientific attainments in connection with gas supply we have had some illustration in the past, says (according to the report in the "Electrician") that "convected heat is the same thing as radiant heat." If he said anything of the kind, we will not publicly challenge him on the point, but will reserve to ourselves the right of entertaining a private opinion on the subject of Mr. Grogan's knowledge in this particular direction.

Honest Opinion Objected to.

Mr. Grogan's remarks contain another point. He says that the "Standard" for June 10 "contains an article written by Mr. Horsnaill, signed by himself as Assoc.M.Inst.M.E., and Assoc.M. Inst.E.E., which, in his opinion, is a perfect disgrace to the profession which Mr. Horsnaill represents; and some of those present who have greater power than he (Mr. Grogan) should take the matter up, and see if they cannot remove Mr. Horsnaill from the Institution of Electrical Engineers." We have quoted these remarks from the "Electrician" report; and it may be suggested that in them Mr. Grogan has, we imagine, laid himself open to serious trouble. But perhaps Mr. Horsnaill will not regard Mr. Grogan's position as warranting any particular notice of his fulmination. It is clear, however, that Mr. Grogan objects to an honest expression of opinion. As to his suggestion that someone should seek to try to remove Mr. Horsnaill from the Institution of Electrical Engineers, we wonder who would be bold enough, under such circumstances, to court the consequences of such an action. [Some extracts from Mr. Horsnaill's article appear in our news columns, p. 62.]

Status Quo Ante.

The discussion under the auspices of the "Point Fives" has not succeeded in standardizing opinions among electrical people. The position, which is made up of personal and material contrarities, remains as it was.

The late Mr. John Allington Hughes, who was for many years Chairman of the Wrexham and East Denbighshire Water Company, left estate of the gross value of £62,333, with net personalty amounting to £38,325.

At Logie Parish Church, Bridge of Allan, last Tuesday, the marriage was solemnized of Mr. Kenneth Aird, youngest son of the late Charles Aird, Esq., of Eastbourne, and Dorothy Helen, daughter of the late Douglas G. Miller, Esq., and Mrs. Miller, of Glen Allan.

DECOMPOSITION OF CARBON BISULPHIDE IN COAL GAS BY HOT PURIFICATION.

By Charles Claude Carpenter, D.Sc., M.Inst.C.E.

[A Paper read before the Société Technique du Gaz en France.]

Lest I should appear too presumptuous in offering for the consideration of the members of the Société Technique de l'Industrie du Gaz en France a paper on the above subject, I wish to preface my remarks with the following explanatory notes in extenuation of my temerity.

In the first place, it has seemed to me that the course for the practical examinations by your Society of a problem which for many years I have considered one of the greatest importance to the gas industry has been cleared by the admirable paper read by M. Guillet at the Congress held last year in Paris.* I trust I may be allowed to offer my congratulations to him on the great interest of his communication, which I have read with much pleasure in the reports of the Congress. In the second place, I should hope that it will be considered only fair and appropriate that a practician should express at Toulouse the respect due to his learned *confrères*, particularly when it is to a man so universally honoured as Professor Paul Sabatier, and when the tribute of admiration takes the form of a description of an industrial application of catalysis by means of nickel.

Previous Processes.

The purification of coal gas by heating it in contact with iron was first suggested by G. H. Palmer, who in 1819 erected an installation for this purpose at Macclesfield. It would appear that this first attempt was not successful. The presence of carbon bisulphide as an impurity in coal gas was suspected a year later (in 1820), when W. T. Brande discussed in the "Philosophical Transactions" a scheme for the purification of gas by causing it to pass through tubes heated to redness. He stated that in examining coal gas he had often noticed the formation of sulphurous acid during combustion. Since the gas examined by him contained no sulphuretted hydrogen, he was led to suspect the presence of some other sulphur compound; and he was confirmed in this belief by the odour of carbon bisulphide evolved, according to him, from gas-mains in streets which had been opened.

In the competition between oil gas and coal gas which took place in 1825 for the lighting of Westminster, the defendants of the former made much of the fact that it was free from sulphur. But it was declared, on the other hand, that carbon bisulphide could not be found in coal gas. In 1852, the Court of Common Council of the City of London made the first appointment of an independent chemist for the examination, as regards quality and purity, of the gas supplied to the public. Their choice fell upon Dr. Henry Letheby, who in his subsequent reports frequently drew attention to the quantity of sulphur existing as carbon bisulphide in the gas supplied to the Metropolis, and attributed the cause to the carbonization of the coal at too high a temperature. He made a modification in the apparatus employed for the estimation of the sulphur, consisting in an argand burner in which the gas to be tested was burnt at the rate of 14 litres (0·5 cubic foot) per hour. Below the burner was placed a glass vessel containing ammonia solution of ·880 sp. gr. Around the burner was a tube, the end of which was curved in trumpet form, by which the products of combustion were condensed in a horizontal cylinder of about 8 litres (0·28 cubic foot) capacity. The sulphur contained in the liquid was estimated by precipitation as barium sulphate in the usual way. The actual presence of carbon bisulphide in coal gas was proved for the first time in 1853 by A. Vogel, who passed a current of coal gas free from sulphuretted hydrogen through an alcoholic solution of potash. After concentration and the addition of acetate of lead, a dark coloration was obtained.

From time to time the deleterious effects of the products of combustion of coal gas upon fabrics, books, &c., have been emphasized. But though both scientific men and the public have been in agreement on the injurious nature of sulphur compounds, no practical steps were taken for their systematic extraction till 1860, when a suggestion, specially deserving of notice, was put forward by the Rev. W. R. Bowditch, the Vicar of St. Andrew's, Wakefield, who six years before had taken out a patent for "improvements in the purification of coal gas." The essential part of his invention was contained in one of the claims in his specification, which runs as follows: "The passage of coal gas over slaked lime, beaten clay, or hydrated peroxide of iron heated below redness, as described above, by which the sulphur compounds contained in what is now called 'purified gas' are decomposed and given off as hydrogen sulphide and carbonic acid; the hydrogen sulphide thus produced, together with the carbonic acid and ammonia, being removed by the ordinary methods of purification." He stated that the best temperature in practice was between 116° and 216° C.—varying according to the quantity of impurity present in the gas.

Bowditch was strongly of opinion that his process of purification should be adopted by gas undertakings; and he had a conference with a number of managers of gas-works, at which he drew their attention to this subject. He estimated that the maximum cost would be 35c. per cubic metre (7s. 10½d. per 1000 cubic feet) of gas; but he pointed out that, assuming a large number of people would not use gas in certain of their rooms unless it was more efficiently purified, their objections would disappear. The result would be a much larger consumption of gas, and an additional profit, which would more than compensate for the greater cost involved in the adoption of his process. He added that, as a result of the simplicity of his method, consumers of gas would themselves be in a position to put up small installations in the cellars of their houses, in order to remove, under their own supervision, the deleterious properties in the gas.

In 1861, Mr. A. Kitt heated gas in contact with refractory bricks for the destruction of carbon bisulphide, according to an idea expressed some time before by Mr. O. Brothers. Mr. Kitt found that, when taking gas of 14 English candles, the illuminating power was reduced to 8·5 candles on heating to 150° C., and that two further consecutive heatings effected a reduction to 5·75 candles. He called attention to this loss in illuminating power as proving the impossibility of the commercial application of such a method as this. In the same year, Mr. Bowditch patented a process for passing gas over metallic oxides heated to from 50° to 150° C., afterwards purifying it by means of lime or oxide of iron, according to the usual methods.

In 1863, Mr. G. Bower took out a patent for the use of heated spongy iron for the purpose of decomposing and removing sulphur compounds—in particular, carbon bisulphide. In the application of his invention, the coal gas, purified or crude, was led through a heated retort containing iron or oxide of iron. The sulphur compounds were decomposed, and the sulphur, entering into combination with the iron, was thus removed from the gas.

In 1864, the London Gas Companies consulted Mr. T. G. Barlow on the removal of the sulphur impurities in coal gas. Mr. Barlow made experiments in collaboration with M. Albert Ellissen, the Chemist at the experimental works of the Paris Gas Company, and, I believe, the respected *doyen* of your Society. Their report set forth that the sulphur impurity in gas varied considerably according to the coal used. While coal from the neighbourhood of Valenciennes gave 17·13 grammes per cubic metre, that from Staveley, in England, yielded 50·4 grammes for a like volume of gas, though the two coals contained almost the same quantity of sulphur. The two experimenters were of opinion that only careful manual sorting of the coal was a satisfactory remedy.

In 1871, Professor A. G. Vernon Harcourt obtained provisional protection for a process having for its object the conversion into hydrogen sulphide of the sulphur (other than sulphuretted hydrogen) in coal gas. For this purpose he used a mass of iron turnings, or wire, or other suitable material, introduced into the retort after it was charged with coal. He assumed that the metallic mass would reach a temperature of dark red, and that it would decompose the carbon bisulphide contained in the gas, forming hydrogen sulphide, which would be readily removable. An alternative method consisted in bringing the gas to a higher temperature before purification by causing it to pass through a system of tubes heated by any method to dark red, and partially charged with material suitable for conducting the heat and presenting ample surface. The process was demonstrated the following year before the Royal Institution in London. After other experiments with chemical absorbents in the cold, Harcourt returned to this method of heating, and, in collaboration with Dr. (afterwards Sir) W. Siemens, the process was tried on an industrial scale in a gas-works in London in 1874. The furnace employed was a modification of the recuperative system with which the name of Dr. Siemens will always be associated. The gas was heated by passing through one of the recuperators, and afterwards over a mass of heated quartz flints, after which it was gradually brought to the ordinary temperature by passing through another recuperator. The operation was performed in a way which was opposite to the usual practice. Considerable leakages occurred in the apparatus, in consequence of fracture of the iron by the heat of the furnace, and the experiments were broken off. Arrangements were adopted to allow of drawing a current of air through the apparatus by means of a chimney, in order to burn the carbon deposited on the surface of the bricks and flints.

Harcourt found that the chemical method would form a very convenient laboratory process for the estimation of carbon bisulphide in coal gas. For this purpose, a Florence flask was filled with quartz flints strongly heated by a gas-burner, and the resulting gaseous products were passed through a normal solution of lead—the coloration produced being compared with a standard tint. In a later apparatus, he suggested the use of balls of refractory earth with oxide of iron heated in a current of gas in order to reduce the oxide to the metallic state. Platinized pumice was eventually used in their place. Harcourt was of opinion that the process could be applied on an industrial scale, but that the question was one for the ingenuity of the engineer rather than for that of the chemist.

In 1876, Mr. T. B. Redwood patented the use of copper turnings by a similar method to improve the quality of coal gas.

In 1878, two gas engineers, J. & F. W. Clark, obtained provisional protection for what seems to have been a serious attempt

* See "Journal," Vol. CXVIII., p. 986.

to apply the heating method on an industrial scale. They remark that, though the elimination of carbon bisulphide was readily done in the laboratory, no practical process had succeeded for doing it on a large scale, despite the fact that carbon bisulphide could be decomposed when subjecting it to a temperature of about 260° C. The inventors found that the principal cause of failure was the difficulty of maintaining at a high temperature a large volume of gas in a chamber of considerable size. They found, however, that by dividing the gas into currents of moderate volume, and by causing it to traverse long narrow passages heated by an outside source, the gas could be maintained at the temperature and for the time necessary for decomposition. They constructed an apparatus in which the gas passed through iron tubes (in order to avoid leakage); and, with the object of easy regulation of the temperature and of keeping the latter sufficiently high without injury to the tubes, they did not heat the latter directly, but by placing them in a chamber of hot air. The tubes in which the gas underwent decomposition were charged with coke or wood charcoal in order to increase the conducting surface necessary for the reaction. The hydrogen sulphide which was evolved was immediately absorbed by oxide of iron. Some further details in regard to these experiments were communicated two years later by one of the inventors, who stated that his experiments had been made with a plant capable of raising the temperature of 1400 to 1700 cubic metres of gas from 15° to 320° C. Yet they found that the quantity of carbon bisulphide was reduced only 25 per cent. In view of this poor efficiency, added to the loss of gas, the reduction in illuminating power, the great expense of heating, and the dangers attending the working of the process, they abandoned the method as impracticable.

The First Use of a Metallic Salt for Effecting the Decomposition of Carbon Bisulphide.

A still more remarkable process was that for which a patent was granted in 1879 to J. von Quaglio. Here is seen, for the first time, the idea of using a metallic salt for the decomposition of carbon bisulphide, and its conversion into hydrogen sulphide. For this purpose, the inventor suggested platinum in the form of metal or sponge, iridium, palladium, ruthenium, or rhodium; also metallic nickel and metallic iron in fine powder. He proposed to use balls of refractory earth previously moistened in a solution of chlorides of the metals. The balls would be contained in iron tubes, heated by the gas from a generator, by hot air, or by superheated steam. The regeneration of the metallic compound in the interior of the apparatus was done by passing a current of air through the tubes while they were still hot. The inventor states that the apparatus could be placed before the ordinary purifiers, or be employed after the hydrogen sulphide had been removed. It has been impossible for me to ascertain whether this process was ever worked on an industrial scale.

Use of Lime in Retorts.

In 1883, trial was made on a large scale, in London and elsewhere, of a project for mixing slaked lime with the coal before charging the retort. This suggestion was abandoned for many reasons; but it has been revived with success at Cheltenham.

In 1884, Mr. L. T. Wright proposed to add air varying in quantity up to 2½ per cent. in proportion to the quantity of sulphur contained in the gas—heating the mixture to between 200° and 260° C., and passing it over animal black.

American Work.

A modification of the Harcourt-Siemens system has been described quite recently by Mr. E. L. Hall, of Portland (U.S.A.). In this process, two chambers built of refractory bricks are used, heated alternately by the combustion in the interior of producer gas—the lighting gas being directed across one or the other of these chambers. The gas to be purified is heated to a temperature of 400° to 900° C., with or without the addition of steam, and the hydrogen sulphide is removed by the usual method. If the proportion of sulphur is very high, the gas may be led through a second apparatus, and the removal of its hydrogen sulphide repeated.

The Evans Process.

Apart from the exceptions already mentioned, engineers appear to have lost sight for many years of the heating process for the decomposition of carbon bisulphide, and to have confined their attention to its extraction by lime. The use of this material has always involved great difficulties and inconveniences; and when, on the recommendation of a Committee presided over by Lord Rayleigh, F.R.S., the compulsory elimination of the sulphur compounds in gas was abolished by Act of Parliament, and gas undertakings were no longer restricted in this respect, they were eager to take advantage of their liberty. The great importance of the question from the point of view of increasing the popularity of gas was nevertheless not lost sight of by the South Metropolitan Gas Company; and Mr. E. V. Evans, their Chief Chemist, was instructed to again study the question from the beginning. In these researches, the catalytic reactions were reproduced on the laboratory scale in the latter part of 1908; and the following year an installation on a large scale was set up at the Company's Bankside works. The apparatus is shown in fig. 1. The difficulties which had been met with in the past presented themselves anew. The percentage of the reduction was much less than the experimental data had given reason for anticipating; and explosions took place in consequence of leakage in the cast-iron retorts, which cracked, and finally melted during the regeneration of the catalyzer.

The Lines of Success.

The problem was referred back for more thorough investigation in the laboratory, with the object of ascertaining which catalyzer required the lowest temperature for the reaction, compatible with a rate of gas passing on which it would be practicable to work; also to discover in what form the catalyzer could be best exposed to the action of the gases, After many trials, it was found that these conditions were fulfilled by the use of balls 25 mm. (1 inch) in diameter impregnated with reduced nickel, obtained by the reduction of the chloride in a current of hydrogen. The most important advance was made in discarding the attempt to obtain the temperature of the reaction by the application of the heat to the outside of the retort containing the catalyzer, and substituting an arrangement, suggested by Mr. Evans, in which the gas was previously heated up to 100° C. below the temperature of the reaction before coming in contact with the catalyzer. This allows of keeping the retort at the practicable temperature of 500° C. Fig. 2 shows the arrangement of the retort and of the system of previous heating for the treatment of 1700 cubic metres (60,000 cubic feet) of gas per day. The installation was kept at work for four months; combustion by a current of air of the deposited carbon being carried out weekly. During this time, 100,000 cubic metres (3½ million cubic feet) of gas were treated; the sulphur being reduced from 88·4 to 27·5 grammes per cubic metre (35·3 cubic feet).

Large Working-Scale Results.

As a result of this trial, we considered the experience acquired was sufficient to justify the erection of an installation on a large scale; and plans were therefore prepared for the laying-down of plant for purifying 57,000 cubic metres (about 2 million cubic feet) of gas per day. This installation, which is shown in fig. 3, consists of forty reaction tubes, 3·5 metres in length and 15·25 centimetres in diameter, through which the gas passes in six streams. The preheating is done by 230 tubes 5 centimetres in diameter and 6·25 metres in length. The plant was started in November, 1911; but, contrary to expectation, it was found that it was capable of

A. Furnaces. B. Retorts containing the Catalyzer. C. Heat Changers. D. Combustion Chamber. E. Arrangements for Preheating the Gas. H. Gas after the Catalytic Treatment. J. Gas before Treatment.

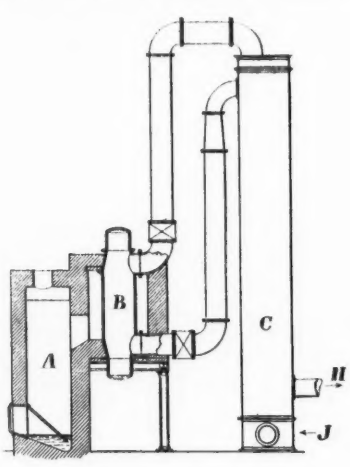


Fig. 1.

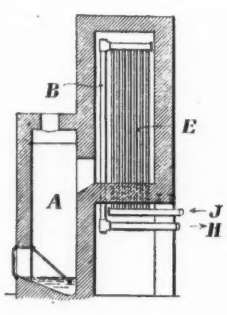


Fig. 2.

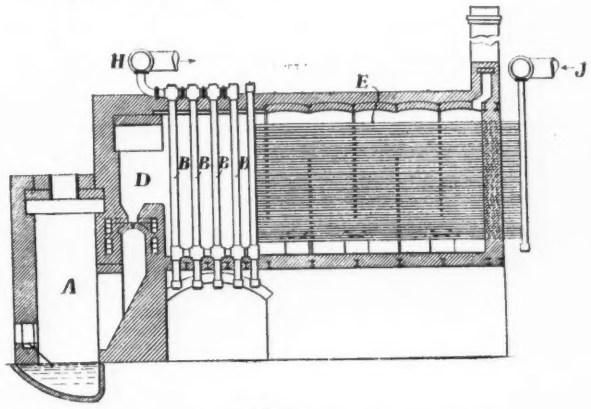


Fig. 3.

LONGITUDINAL SECTIONS.

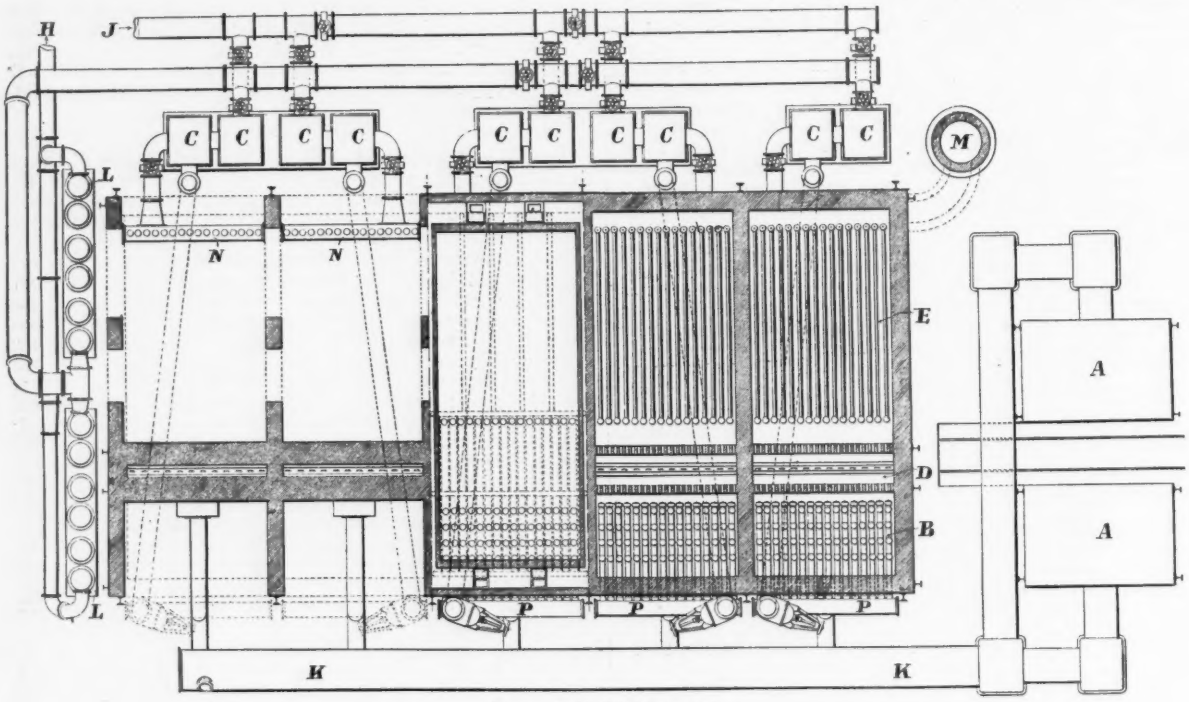


Fig. 4.—SECTIONAL PLAN.

A. Furnaces. B. Retorts containing the Catalyzer. C. Heat Changers. D. Combustion Chamber. E. Arrangements for Preheating the Gas. H. Gas after the Catalytic Treatment. J. Gas before Treatment. K. Pipe conveying the Producer Gas. L. Refrigerator. M. Chimney. N. Inlets to the Preheaters. P. Outlets from the Heat Changers.

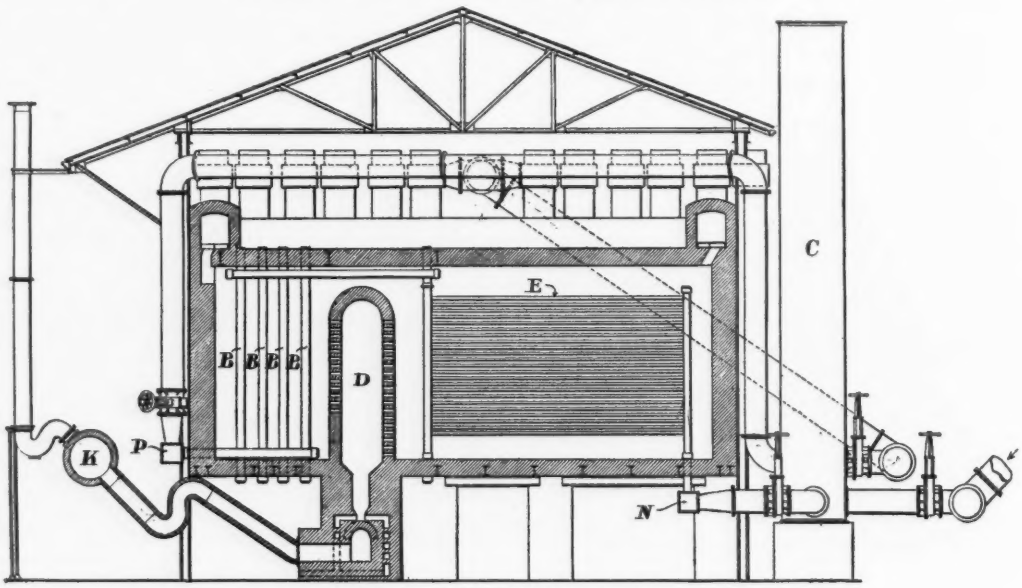


Fig. 5.—LONGITUDINAL SECTION.

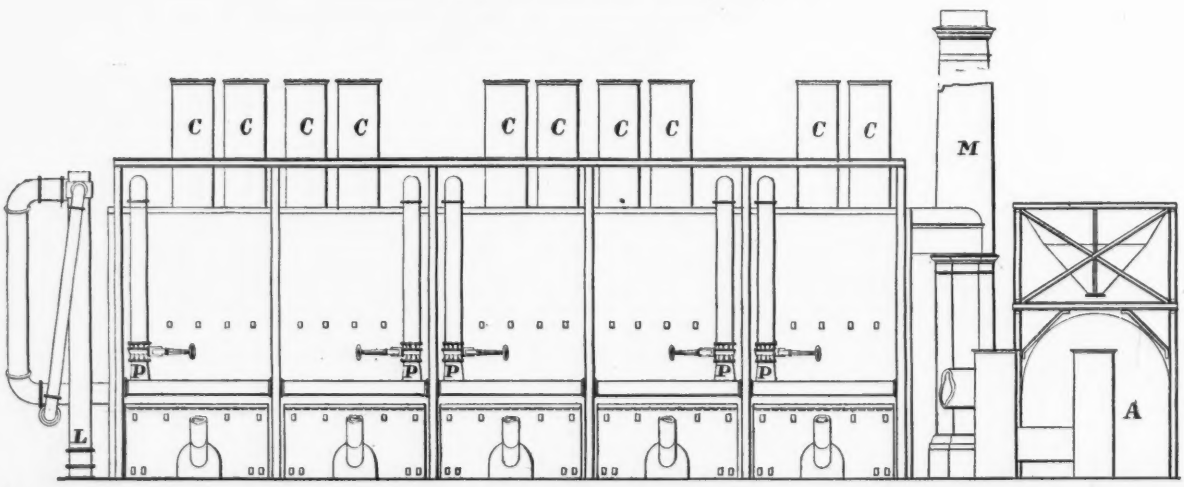


Fig. 6.—LONGITUDINAL ELEVATION.

treating only 42,500 cubic metres (about 1½ million cubic feet) per day, in consequence of the relatively low temperature of the preheated gas. This was remedied, to some extent, by adding regenerators, or compensators, of heat; and the installation was again started. It was found, however, there was still room for improvement, and it was decided to introduce a new design.

The installation is at work at the present time, and does not seem to have at all deteriorated. The fact that the catalyzer is still as active as at first is seen from the following table, which gives, in addition, the average results obtained during each period of work—that is to say, in the intervals during which the operation of the installation was interrupted for the removal of the deposited carbon by air. The sulphur contained in the gas at the inlet and outlet is stated, as also the percentage of reduction effected.

Phase.	Quantity of Gas Treated.	Average Sulphur in the Gas. Grammes per 100 Cubic Metres.		Average Reduction of Sulphur.
		Inlet.	Outlet.	
	Cubic Metres.			Per Cent.
1	674,474	76·75	24·14	68·5
2	892,214	73·76	19·78	73·1
3	680,757	75·11	19·42	74·1
4	1,031,761	52·30	17·69	66·2
5	1,114,765	69·02	20·38	70·4
6	1,023,526	73·97	19·23	74·0
7	948,644	72 43	17·22	76·2
8	1,024,319	84·13	19·14	77·2
9	1,076,617	86·29	17·00	78·8
	8,464,077	73·08	19·32	73·5

Since its erection, 8,464,000 cubic metres (about 300 million cubic feet) of gas produced by the distillation of 23,673 metric tonnes of coal have been treated. The cost, not including the secondary purification from hydrogen sulphide, is as follows:—

	Centimes per 100 Cubic Metres of Gas.	Equivalent per 1000 Cubic Feet.
Fuel	5·47	0·148d.
Manual labour	1·41	0·039
Interest, depreciation, and repairs (15 per cent. on 48,000 frs.)	6·25	0·168
	13·13	0·355d.

Larger Working Installation—Old Kent Road Plant.

I pass now to the description of the largest installation we have put down, and with which we have treated our whole production of gas at the Old Kent Road works of the South Metropolitan Gas Company since the end of January of this year. This installation is capable of decomposing the bisulphide of carbon contained in 283,000 cubic metres (about 10 million cubic feet) of gas per day. It is shown in figs. 4, 5, and 6.

For convenience in work, it is divided into five units, fed by an exterior gas producer, so that the necessary temperature can be easily regulated. The arrangement provides for the possibility of putting one unit out of use for the regeneration of the catalyzing material during the maximum production of gas. The combustion chambers are placed between the retorts or the reaction tubes and the preheating tubes; and the current of the products of combustion from the heating gas can be regulated in one direction or the other. In practice, it is found necessary to regulate only in the direction of the preheater. It may be considered that the part played by the furnace consists in the raising of the temperature of the gas to the additional heat necessary for the reaction, and in preventing any fall of temperature from radiation during the passage of the gas through the catalyzer.

The direction of the gaseous stream is first through a couple of cross-current generators, then to a preheating system and to the reaction tubes, from which it returns to the compensators or regenerators, where it gives up the greater part of its heat to the inflowing gases. Owing to the improvement made in the preheating of the gas, its temperature can be kept at 410° C. before entering the catalyzer. As a result, the temperature of this latter has been reduced from 500° to 430° C. No difficulty has been experienced in the working of the installation, which requires very little supervision, and is only of the kind customary in gas-works.

Efficiency Working.

The following table shows the yield from this installation since it was started working:

	Sulphur in the Gas before Treatment. Grammes per 100 Cubic Metres.	Sulphur in the Gas after Treatment. Grammes per 100 Cubic Metres.	Sulphur in the Gas after Treatment. Grains per 100 Cubic Feet.
Maximum	141·1	19·9	8·7
Minimum	36·6	13·3	5·8
Average for the entire period.	92·2	17·8	7·8

equal to 80·7 per cent. reduction.

There are considerable variations in the quantity of the sulphur compounds produced by the distillation of English coals from various sources. The following table shows the efficacy of the installation with respect to dealing with gas containing much or little sulphur.

Coal Carbonized. (Identifying letters.)	Gas before Treatment.	Gas after Treatment.	Reduction. Per Cent.
	Sulphur in Grammes per 100 Cubic Metres.		
	Maxima.		
A and B	130·7	20·4	84·3
C, D, and E	140·6	19·1	86·4
C, D, and F	144 3	19·9	86·1
E and F	129·1	22·9	82·1
Coal supplied	141·1	19·9	85·8
—	127·1	19·7	84·4
—	133·5	20·6	84·4
	Minima.		
F	64·1	16 3	74·5
F	55·9	14·3	74·4
G	64·6	14·1	78·1
Coal supplied	36·6	13·3	63 5
—	61·6	14·0	77·2

Improvements.

Since starting the installation, 18,400,000 cubic metres (about 650 million cubic feet) of gas, equivalent to 50,800 metric tonnes of coal, have been treated (up to April 21, 1913). The quantity of carbon bisulphide decomposed during this time corresponds to 13·5 tonnes of sulphur, or 42 tonnes of sulphuric acid.

As a whole, the installation is yet imperfect. The losses of heat are still considerable, and the cost of installation in the first instance too great. But we see means for remedying these defects in the future. The improvement will be introduced into the plans for the application of the process at the East Greenwich works of the Company, which has a daily production of 700,000 cubic metres (nearly 25 million cubic feet) of gas.

Preparation of the Nickel Carbonyl.

Frequent tests have been made for the discovery of nickel carbonyl by leading the gas after treatment through a heated combustion tube; but no deposit of nickel has been obtained. Scientific investigators into this question have shown that nickel carbonyl is decomposed completely at 200° C.; but we take the precaution to pass the gas into the catalyzer only when the temperature of the latter is above 300° C.

As regards the reaction, it has been shown conclusively, by laboratory experiments, that it is according to the equation:

$$CS_2 + 2H_2 = 2H_2S + C.$$

When pure materials are employed, the carbon deposited on the catalyzer is in the theoretical proportion to the quantity of carbon bisulphide decomposed. It is this carbon which reduces the activity of the catalyzer by protecting it from contact with the gas—the loss of activity being shown by daily chemical tests. Each unit works thirty days before combustion of the deposited carbon becomes necessary. The process requires careful manipulation, and the temperature has to be reduced for a time. It is spread over a period of four to five days, so as to maintain the temperature below the limits at which it would be prejudicial to the metal of the reaction tubes. The process is finished when the escaping gases are free from carbonic acid. Reckoning upon the volume of carbonic acid evolved, the quantity of deposited carbon has been found in some cases to be 50 per cent. in excess of the calculated quantity. The decomposition of the hydrocarbons may be the cause of this, but the quantity is negligible. This is shown by the following tests, which were made before and after treatment of the gas:

Gas before Treatment.	Gas after Treatment.	—
14·05	14 05	Illuminating power in English candles
5248	5288	Calorific power in calories per cubic metre
10·40	10·78	Naphthalene in grammes per 100 cubic metres
50·80	42·90	Hydrocyanic acid ,, ,, ,,
1·82	1·80	CO_2 per cent.
3·61	3·79	C_nH_m ,,
0·27	0·07	O_2 ,,
8·85	8·62	CO ,,
26·62	27·45	CH_4 ,,
52·45	52·19	H_2 ,,
6·38	6·08	N_2 (by difference)

The Worth of the Process.

In the preceding description, I have sought to direct attention to the efforts made for the purification of gas by heat; and I have described the success which we have attained in this direction. Another side only of the problem requires to be considered—that is to say: Is the solution worth the cost? My answer is emphatically in the affirmative. Flame was regarded by the Greeks as the emblem of purity; and I believe that the day is not far distant when its value for hygienic illumination will be universally recognized. But the flame itself must be pure, or contain merely a negligible quantity of impurities. At the present time, we are near to this end, when the products of combustion of gas will not be different from that other form of combustion which we call respiration, while they offer the advantage of possessing immense sterilizing properties owing to the temperature, which is 800° C. as compared with 35° C. Gas will thus become the ideal source of light at night, as the sun is by day.

THE EXTRACTION OF CARBON BISULPHIDE FROM GAS BY THE "ATHION" PROCESS.

By Herr F. Kuckuk, Manager of the Heidelberg Gas-Works.

[Abstract Translation of a Paper read at the Meeting of the German Association at Strassburg.]

At the meeting of the German Association at Frankfort in 1909, Professor H. Bunte, in referring to the quality of gas which could reasonably be supplied—having regard to the present technical position of the industry—made a statement about the normal impurities of crude coal gas to the following effect:—

There is no difficulty in supplying coal gas which is free from sulphuretted hydrogen; but traces of other sulphur compounds, chiefly carbon bisulphide, are not removed in the purification of the gas. Notwithstanding strenuous efforts in recent years, a practical process has not been discovered for absorbing the small quantities of these compounds. It is eminently desirable that these efforts should soon prove successful, in order to get rid of certain objections to the use of gas, especially for heating, and in order that some coals which are otherwise suitable for gas making, but contain a lot of sulphur, may become available for use on gas-works.

Gas having now become indispensable for cooking and heating, it is more than ever desirable that the removal of carbon bisulphide should be achieved. The sulphur compounds left in the gas are, so far as Germany is concerned, of no importance from the hygienic standpoint. But there are practical reasons why they should be extracted. For instance, Dr. Robert Schaller, of the firm of glass manufacturers, Schott and Genossen, of Jena, spoke in April last of the destructive action of the sulphur compounds in the products of combustion of gas as follows:

The substance of the glass is injured not only by the heat, but by the gaseous products of combustion. After a time, ranging from a few hours upwards, chimneys become clouded with a dust-like haze, which ultimately forms, particularly where the products of combustion are concentrated, a deposit which is soluble in water. If the gas is lighted again, after the chimney has cooled, a few specks of water are deposited on the glass in the first moment or two after lighting, and are then volatilized. But in this brief time, the deposit has been dissolved, and when the water is volatilized, it is redeposited; no longer, however, as a uniform coating, but in spots corresponding with the previous location of the tiny drops of water. This may be constantly observed with chimneys of incandescent burners which have been in use some time. If the deposit is dissolved in a little water and the latter then evaporated, beautifully shaped crystals are left. Chemical analysis discloses that they consist of sodium sulphate. The sulphate can only have come from the sulphur in the gas. The sulphur products have attacked the surface of the glass, extracted sodium from it, and thus formed the sodium sulphate. As the production of vapours of sulphuric acid continues as long as the burner is alight, the attack on the glass goes on progressively, and its surface soon becomes obscured, and the dullness ceases to be entirely removed by washing. The strength of the glass has been diminished by the attack, and it will break from slight causes. All kinds of glass are subject to this attack, which must be allowed for as long as the gas is not completely purified from sulphur compounds. Chimneys which are exposed for a long period to the flame naturally show more evidences of the attack than less durable chimneys which have to be renewed more frequently from breakage or similar causes.

Investigations by other technical men have repeatedly shown that the white, flaky deposit which occurs on the underside of the copper bells ("smoke-consumers") of pendants, &c., consists chiefly of copper sulphate, and that the sole cause of the formation of this deposit is the sulphur in the gas consumed. This white deposit is formed wherever the sulphurous acid produced by the combustion of coal gas comes in contact with copper or its alloys, such as brass. Thus with inverted burners, the products of combustion in their upward course pass brass portions of the burner, and a white deposit forms thereon. The burner-tube in particular very soon becomes coated with copper sulphate. When the white deposit attains a certain thickness, particles fall away, and if the glass-ware extends beneath the burner, collect in it. Other metals are attacked in the same way—with zinc, zinc sulphate is formed; with iron, ferrous sulphate.

The removal of the sulphur compounds, other than sulphuretted hydrogen, from gas, has, however, always presented great difficulty. In English towns, it has demanded special attention, because it has been found that the bindings of books in the London libraries have been attacked by sulphuric acid. Hence the results of the new "Athion" process for the removal of carbon bisulphide, with which trials have been carried out at the Heidelberg Gas-Works, are of great interest. By this process, the gas, having been first wholly deprived of tar, ammonia, and sulphuretted hydrogen, is next washed with a solution of potassium carbonate, in order to effect the complete extraction of carbonic acid. The potassium carbonate, by taking up carbonic acid, becomes converted to the bicarbonate; and when the solution of the latter is boiled, the salt is re-converted to the simple carbonate—carbonic acid being liberated. The solution of potassium carbonate therefore acts continuously in a cycle—*i.e.*, after being saturated with carbonic acid in the washers, it is deprived of it by boiling, cooled, and returned to the washers. The carbonic acid must be removed from the gas, because its presence would render the agent used for the absorption of carbon bisulphide unserviceable. Carbon bisulphide is absorbed by the "Athion" material, which is a compound of alkali and cellulose, obtained by treating cellulose sulphite with soda lye. The porous material, which results after rolling and crumbling fine, is spread on grids in purifying vessels, in the same way as oxide. Carbon bisulphide converts the soda-cellulose into cellulose xanthogenate, or viscose, which is the raw material from which cellulose hydrate and formyl-cellulose are obtained. The last-named body is used in the manufacture of non-inflammable celluloid.

The method has been tested in an experimental plant erected for the purpose at the Heidelberg Gas-Works. In practice, the process will be carried out by means of a washer with spraying nozzles, and a simple dry purifier. In the trials at Heidelberg, English coal containing a relatively high proportion of sulphur has been purposely used; and consequently the crude gas has contained a considerable quantity of carbon bisulphide. Thus, with gas containing 30·75 grains of [? sulphur as] carbon bisulphide per 100 cubic feet, 75 per cent. has been regularly removed, so that only 7·87 grains have been left in the purified gas. Ten tons of "Athion" absorbed 1·25 tons of carbon bisulphide; so that with gas containing 45 grains per 100 cubic feet (a quantity which never occurs when German coals are being carbonized), 10 tons would purify over 35 million cubic feet of gas.

In the experimental plant, potassium carbonate removed 87 per cent. of the carbonic acid present in the gas—reducing it from 2·7 to 0·35 per cent., with a rate of flow of two-sevenths of an inch per second. The last traces of carbonic acid have been extracted by a lime purifier. In the present plant, a small vessel containing potassium carbonate solution has been placed after the potassium carbonate scrubber, for the purpose of making good the small quantities of solution unavoidably lost from the scrubber. There is, next, the small lime purifier, which the author suggests should be retained, even if it proves possible, as he hopes will be the case, to extract the last fractions of carbonic acid by means of potassium carbonate solution. The employment of the latter solution involves but little expenditure, as it is used in a cycle, and, being circulated through closed apparatus and pipes, there is only a trifling loss of it incurred when in continuous operation.

The author is not yet able to give reliable figures for the cost of working the process. He would mention, however, that experiments are being made at the Waldhof Cellulose Works, with a view to utilizing the cellulose recovered from the "Athion" material after it has been fouled by carbon bisulphide. It is hoped that a bye-product will be obtained which will reduce to a minimum the cost of using "Athion" for purification. The quantities of carbonic acid washed out of the gas are so large that they also should have a considerable commercial value; and it is contemplated liquefying the carbonic acid, and putting it on the market. Trials are now being instituted with this purpose in view.

It has always been a primary object in Germany to increase the returns from gas-works by recovering valuable bye-products; but hitherto no one has succeeded in recovering two of the chief impurities of coal gas—viz., carbonic acid and carbon bisulphide—as serviceable bye-products. The methods so far available for their removal have been costly, and have yielded no bye-products. Consequently, they have not been introduced in German gas-works, where economy of working is paramount.

While the experiments at Heidelberg have not yet been finished, they seem to the author to indicate that a method has been found which will ultimately give wholly satisfactory results.

The diagrammatic sketch shown of purifying plant for the removal of carbonic acid and carbon bisulphide from gas was as follows: From the station-meter the gas passes either upwards or downwards through a tower-scrubber, in which it is sprinkled from three tiers of nozzles with potassium carbonate solution, which passes from the base of the scrubber into either of two closed tanks, from which it is again pumped up to the scrubber. From the latter the gas passes into a vessel which appears to serve the dual purpose of a catch-pot for the spray of solution carried forward by the gas and of a reserve store of solution from which losses in the scrubber circulation are made good. From this vessel the gas passes through a catch-lime purifier, and then through the purifier containing "Athion" material.

COAL GAS AS A MOTOR FUEL.

By M. André Grebel.

[A Paper read before the Société Technique du Gaz.]

A question of the hour is the increase in the price of petrol or benzol; yet there is no need to lay undue stress upon it, since the cost of the fuel is only a moderate proportion of the total expenses of motoring. Nevertheless, the increased cost does threaten to restrict the use of commercial motor vehicles. The cause undoubtedly is the inevitable law of supply and demand. Dismissing, with reference only, the means which have been suggested for the use of benzol and heavy petrol spirit, such as special carburettors or motor-engines of suitable design, we may turn to a fuel which does not appear to have suggested itself to anyone—namely, compressed coal gas. In many respects it would be ideal, since it is in the gaseous state, its quality and price are subject to little variation, and its production is limited only by the exhaustion of

the coal mines. It could be applied to existing motors by substituting a mixing-jet for the carburettor. It may be taken that gas has a thermo-dynamic efficiency at least equal to that of benzol or petrol.

The suggested employment of gas is not subversive, for there are at present in industrial use compressors with intermediate coolers working at pressures of 200 kilos., and also receptacles which are in general use for the transport of highly compressed hydrogen, oxygen, and carbonic acid. Suitable tubes for the storage of the gas at a pressure of 140 atmospheres could be attached to the chassis, or longer tubes, connected by collectors, used as in the vehicles conveying hydrogen for purposes of military aëronautics. As regards the fears which might be entertained as to the use of combustible gases at high pressures, long experience of hydrogen tubes has shown that there is no special danger.

In compressing coal gas of 5150 calories per cubic metre to 140 atmospheres, there is a loss of about 635 calories in consequence of the liquefaction of benzol and other hydrocarbons. The gas then consists almost entirely of hydrogen, methane, carbonic oxide, and nitrogen, with some hydrocarbons which are not liquefied at this pressure. The loss in volume amounts to about 5 per cent.; so that the calorific power of one cubic metre (35·3 cubic feet) after compression is 4752 calories. At the price of 15 c. per cubic metre, the cost of the compressed gas would be 15·8 c., allowing nothing for the deposited benzol. In the case of a small installation of (say) 50 cubic metres per hour and 35 H.P., the cost of the motive power would not exceed, per cubic metre of compressed gas, 6 c. × 0·7 = 4·2 c.; for even in a small engine of this kind the horse-power-hour should not amount to more than 6 c., including all cost of depreciation, maintenance, &c. Depreciation, maintenance, &c., would scarcely exceed 6 c. Thus the net cost of a cubic metre of compressed gas brought to atmospheric pressure and representing 4750 calories, would be 15·8 c. + 4·2 c. + 6 c. = 26 c. For the equivalent thermo-dynamic efficiency, gas at 26 c. per cubic metre would be matched by petrol of 7600 calories per litre, 41·5 c., and by benzol of 8500 calories per litre, 46·5 c.

In Paris, where petrol pays a duty of 19·8 c. per litre and benzol one of 15·2 c. per litre, the equivalent of gas at 26 c. per cubic metre would be 21·7 c. per litre without duty in the case of petrol, and 31·3 c. in the case of benzol. The actual retail price of petrol in Paris is 70 c., and outside Paris 50 c.; the figures in the case of benzol being 50 c. and 35 c. In large quantities the prices are more favourable; but the majority of gas companies would be glad to supply gas at 12 c. to 14 c. per cubic metre to large consumers, and, moreover, the cost of the compression would be much less in a large installation than in that instanced above. Moreover benzol, with petrol, is likely to increase in price, while gas tends to become cheaper.

It remains to consider whether the difficulties in the way of practical application are excessive. As regards the containers for the gas, tubes holding 7 cubic metres (250 cubic feet) would be 2 metres (6 ft. 6 in.) in length and 20·2 centimetres (8 inches) in diameter, and would weigh 10·3 kilos. (22 lbs.) per cubic metre of gas. Therefore ten tubes, each 2 metres in length, would represent a supply of fuel equal to about 40 litres (8¾ gallons) of benzol or 50 litres (11 gallons) of petrol. The total weight of these tubes, with their fittings, would not be greater than 750 kilos. (1700 lbs.), and would cost about 750 frs. (£30).

In adding the weight of 750 kilos. to a petrol vehicle for the use of gas, the load which could be carried would fall within the customary limits—viz., 45 per cent. of the total weight. Even with the Saurer vehicles (which weigh 5 metric tons, are of particularly stout build, and have a dead-weight, inclusive of the carriage, of 4 tonnes), the possible load would be reduced only to 4·25 tonnes. In order to provide the same service as that of a motor omnibus of 7 tonnes, carrying 100 litres of benzol, and consuming 50 litres per 100 kilometres, it would be necessary to charge with gas up to 150 cubic metres—a quite practicable proposition.

It would seem that, for the time being, a system such as the one suggested should be confined to large commercial vehicles which travel within a comparatively limited area in which they are able to take in fresh supplies of gas. Gas companies would find it to their interest to facilitate a trial of the system; and certain of them (those using motor vehicles for their own purposes) could reckon the gas at prime cost, and could ensure a small expense for compression. They would undoubtedly find economy compared with benzol, even when purchasing the latter very cheaply.

In a note appended to his paper, M. Grebel briefly reviewed the attempts which have hitherto been made to use compressed gas as a fuel for motor vehicles—viz., by MM. Delamare-Debouteville and Malandin in 1884, by the Paris Gas Company in 1893, by the German Continental Gas Company about the same time, and by the Gas-Traction Company. From 1897 to 1899, tramway services worked by compressed gas were started at Blackpool and also at The Hague.

The Waverley Association of Gas Managers will hold their ninety-seventh meeting in the Cathedral Hotel, Edinburgh, next Friday, under the presidency of Mr. Thomas Black, of Coldstream. There will be the usual address by the President and a discussion thereon, after which the various officials will be appointed for the ensuing year.

SOCIÉTÉ TECHNIQUE DU GAZ EN FRANCE.

Subjects Introduced at the Congress.

As mentioned in the review of the proceedings at the recent Congress of the Société Technique which appeared in the "JOURNAL" last week, several subjects were brought under the notice of the members with the view of evoking discussion. The following were among them.

MARKING GASHOLDERS TO GUIDE AVIATORS.

In order to enable pilots of aëroplanes and dirigible balloons to reconnoitre in times of war, and avoid running the risk of losing themselves in times of peace, the French Aërial League have been engaged lately in formulating a scheme for putting a guiding mark on the principal buildings in towns. This is a somewhat difficult matter. In the night, luminous signals may be easily installed; but in the daytime recourse can only be had to conventional signs, placed in high positions, and made as visible as possible. Æsthetic reasons and administrative difficulties prevent the adoption of this kind of marking; and the officials of the League addressed themselves to the managers of gas-works, as they considered gasholders might have upon them inscriptions easily seen by pilots.

A Special Committee of the Société Technique, of which M. Rouland, the General Manager of the Paris Gas Company is the Chairman, has also been engaged in ascertaining the best means of marking to be applied to the holders in 830 gas-works in France; and at the recent meeting, a communication on the subject was made by M. Laurain. He pointed out how, on the charts for aërial navigation, intended marking might be done from any point by means of his geographical co-ordinates, longitude and latitude. In order to distinguish longitudes east or west of the meridian, the longitudes towards the east have to be underlined horizontally. A town can be distinguished by its situation expressed in degrees, and in tenths and hundredths of a degree, by taking care at first to indicate the latitude. For example: $6°.3.5 - 1°.22$. It is this designation which it is suggested should be painted upon the crowns of gasholders. The figures should be 6 ft. 6 in. long, and be painted black upon a light ground or else in white upon a black ground; the inscription being oriented from west to east. The shape of the figures has been slightly modified in order to avoid confusion between the 9 and 7, the 8 and 5, and the 3 and 8. As many gasholders are coated with tar, it will be necessary to take precautions to ensure the preservation of the white paint. The inclusive cost of painting a letter 6 ft. 6 in. high in Paris varies from 1·5 frs. to 1·7 frs.

WASHING OF CLINKER AND UTILIZATION OF RESIDUAL FUEL.

M. Laurain described the very complete installation for this purpose at the Landy works of the Société du Gaz de Paris. The clinker of all sizes is loaded on waggons of 880 cubic feet capacity, and conveyed to the washers. The production of clinker is 8 cubic metres [282 cubic feet] per battery of double furnaces for a consumption of 36 cubic metres [1280 cubic feet] of coke—say, 25 per cent. by volume of the coke consumed in the producers. The washer, constructed by Dalbrouze, Brachet, and Co., can deal with 100 cubic metres [over 3500 cubic feet] in ten hours' working. The clinker is tipped from the waggons into a hopper, taken up by a bucket elevator, and passed to a cylindrical screen with three sizes of perforations, 19 ft. 6 in. long and nearly 1 foot in diameter, making fifteen revolutions per minute. The breeze is here sifted as follows:

1. Dust and breeze, passing 0·7-in. mesh.
2. Small clinker, passing 2·34-in. mesh.
3. Medium clinker, passing 3·9-in. mesh.
4. Large clinker, the remainder.

The dust and breeze are removed. The fine and medium sized clinker is sent to the washing boxes, which have a surface of 5 feet by 4 ft. 6 in. The bottoms of these are made of metal sheets perforated with 0·04-in. mesh. They are fed with a continual flow of water, which is kept in motion by a piston worked by an eccentric. The coke rises to the surface and is carried off by the water. The clinker sinks to a false bottom, and is cleared out. The water is filtered and used again. The average results obtained are:

Usable coke	50 per cent.
Ash	33 ,, ,,
Small and medium clinker	10 ,, ,,
Large clinker	7 ,, ,,

The clinker taken from the washer is divisible into:

Ash	66 per cent.
Small and medium clinker	20 ,, ,,
Large clinker	14 ,, ,,

The ash contains 32 per cent. of carbon, and, with 11·8 per cent. of moisture, has a calorific value of 2477 calories [9754 B.Th.U.]. The small and medium clinker has a carbon content varying from 15 to 44 per cent., and the large an average of 17 per cent. The coke recovered is fairly clean, and contains 82 per cent. of carbon reckoned dry, and it can well be used for producers.

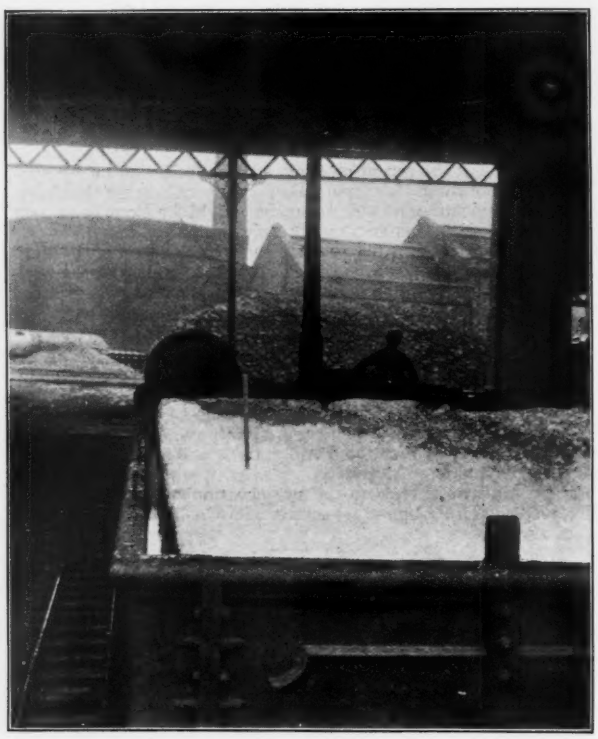
The power required for the process is 1·12 kilowatt-hours per cubic metre [35·3 cubic feet] of clinker dealt with, for pumps, elevators, rolling screen, &c., and the consumption of water for the same amount is 986 litres [217 gallons]. By a slight modification this latter will be reduced to one-fifth or perhaps to even one-tenth.

A NAPHTHALENE EXPERIENCE AT STAFFORD.

Two very interesting photographs have been forwarded to us by Mr. W. M. Valon, the Engineer of the Stafford Corporation Gas-Works, which present to us a phenomenon regarding which perhaps some of our readers may be able, from experience, to suggest an explanation. The photographs are of two purifier-boxes; and the white material seen above the oxide is a deep deposit of naphthalene.

Let us explain the circumstances. At Stafford there are ten purifiers, four of which (25 ft. by 20 ft. by 5 ft.) are used to properly purify the gas; and six are employed as catch-boxes. The first two of the latter (which are the ones shown in the photographs) are also 25 ft. by 20 ft. by 5 ft. deep, and are under cover. The remaining four are very old, and of somewhat small dimensions—18 ft. by 12 ft. by 44 ft. Now the strange point is that, although a large amount of naphthalene is deposited on the oxide in the two catch-boxes under cover, there is only a slight trace of the material in the four boxes in the open. This year in the two boxes, the deposit was 10 inches deep; and the oxide itself is impregnated with tiny flakes of naphthalene. The two troublesome boxes are annually filled with new oxide; but whether or not this has anything to do with the difficulty has not been ascertained by Mr. Valon, by using old oxide in them. The foreman, however, says that, when some time ago he used old oxide in the two boxes, there was much less naphthalene deposited.

Naphthalene does not occasion trouble anywhere else on the works, nor is there much trouble on the district. During the winter, no complaints are received; and if the summer is very hot, and complaints commence, an end is put to them in two or three days by the use of a small quantity of "Solvene" in a specially constructed washer. Under the circumstances, it must be agreed that it is strange such a deep deposit is obtained in these two boxes every year. Is there anything that is likely to particularly affect the temperature of the two boxes?



CENTRAL SUSPENSION INSTALLATIONS.

The accompanying photographs illustrate the central lamp-suspension installation in Bath Street, Glasgow, in which are employed the positive-acting weight-relieving suspension device and the patent self-sustaining winches, wall-rosettes, &c., of the London Electric Firm, of Croydon. The distance from the ground to the bottom of the lamp is 25 feet. It may be pointed out that the specialities of the London Electric Firm here referred to were described in the "Journal" for Feb. 25 last (p. 533). Similar installations to that now depicted have been put up in Paradise Street, Birmingham, and elsewhere. For the City of London, where the firm are supplying a number of sets, the method is somewhat different; their patent automatic joint-suspender being used. In this case, the lamp travels horizontally along the wire, and is then lowered down to the side-walk. No flexible or knuckle-jointed tubing is employed.

Central Lamp Suspension in Glasgow.

Lowering of a Centrally-Suspended Lamp.

GASHOLDERS: THEIR CONSTRUCTION AND USE.

By Herr Ernst Körting, of Berlin.

[A Lecture Delivered to the German Gas Association, June 25.]

I have been invited to speak to you to-day on the subject of gasholders. I believe there is scarcely any portion of their plant which is of more importance to gas engineers than the holder, without which the distillation of coal in the service of central gas supply would be simply inconceivable.

The system of using a fixed balloon of firm material as a store, and for balancing-up production and consumption, is part of that foundation of great ideas and discoveries on which our industry was first founded, and which has made it possible to combat successfully such dangerous opponents as mineral oil in the eighties, and electricity at the present day. But the gasholder was still more important in the early stages of our industry—fifty and a hundred years ago—than it is to-day. Gas was, in those days, used only for lighting; and the production had to be collected during a whole day, and was then used up in a few hours. It was therefore reckoned that the holder capacity must be equal to a full twenty-four hours' consumption; and as, by the help of artificial light, the winter evenings were often made as long as in the summer, the size of the holder was determined by the day of largest consumption—100 per cent. of this production, and in London (with its fogs) 120 per cent. and more, being generally reckoned.

In these circumstances the gasholder formed a very important part of the outlay on gas-works construction. An old rule stated that manufacturing plant, storage, and distribution divided capital outlay equally between them. And this can well be understood, when it is remembered that, in those days, the erection of a gasholder was a more expensive piece of work than it is to-day, whereas retort-benches and apparatus were comparatively easy and cheap to build, and the distribution system was not then so overburdened with services, meters, &c., as it is to-day. But we all know that to-day heating and industrial gas plays a more important part than lighting gas; and that its consumption is highest in the daylight hours, while extending to a certain degree over the whole of the twenty-four hours. Therefore only 60 per cent. of the maximum consumption is now required as holder capacity.

Apart from these considerations, vast changes in gas consumption must be taken into account. I once made a comparison in Berlin of two winter months, January and December, with the two summer months, June and July—for the last thirty years. In 1880, the winter consumption was four times that of the summer; three times as large in 1895; and only double in 1912. Last year, the total consumption was 237 times the highest day's output;

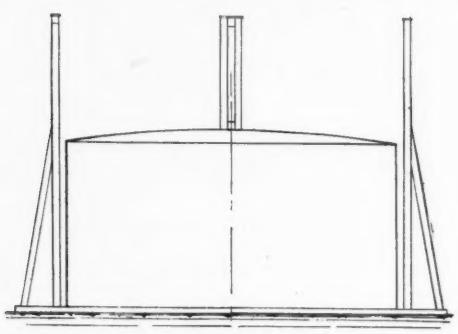


Fig. 1—Old Gasholder at Cologne.

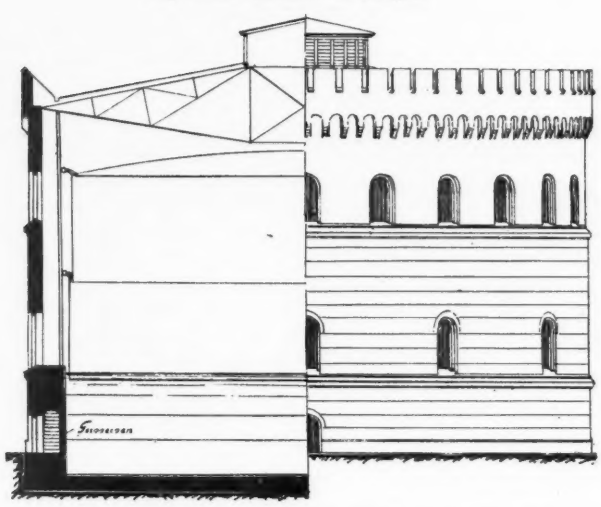


Fig. 2—Gasholder at Gitschinerstrasse, Berlin; constructed 1845.

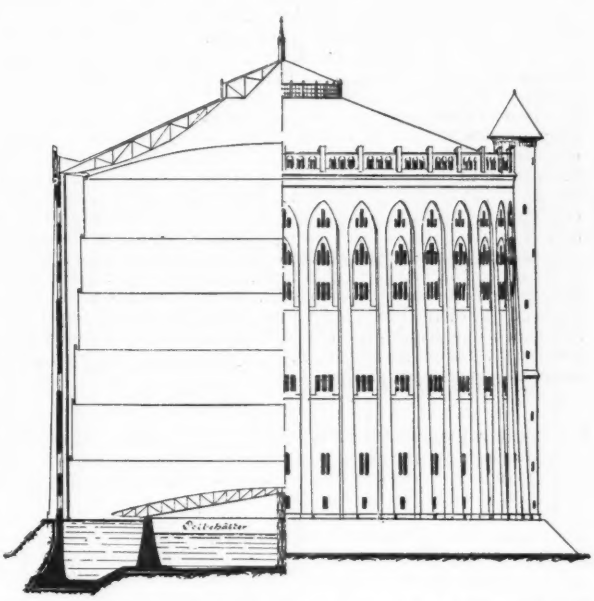


Fig. 3—The Tegel (Berlin) Gasholder. Capacity 7,944,000 Cubic Feet.

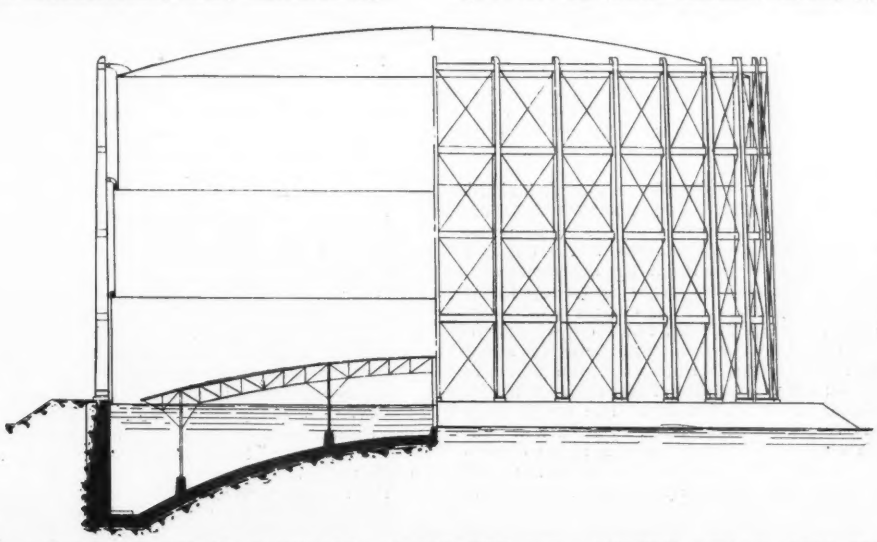


FIG. 4—MARIENDORF (BERLIN) GASHOLDER; CONSTRUCTED 1902. CAPACITY 5,296,000 CUBIC FEET.

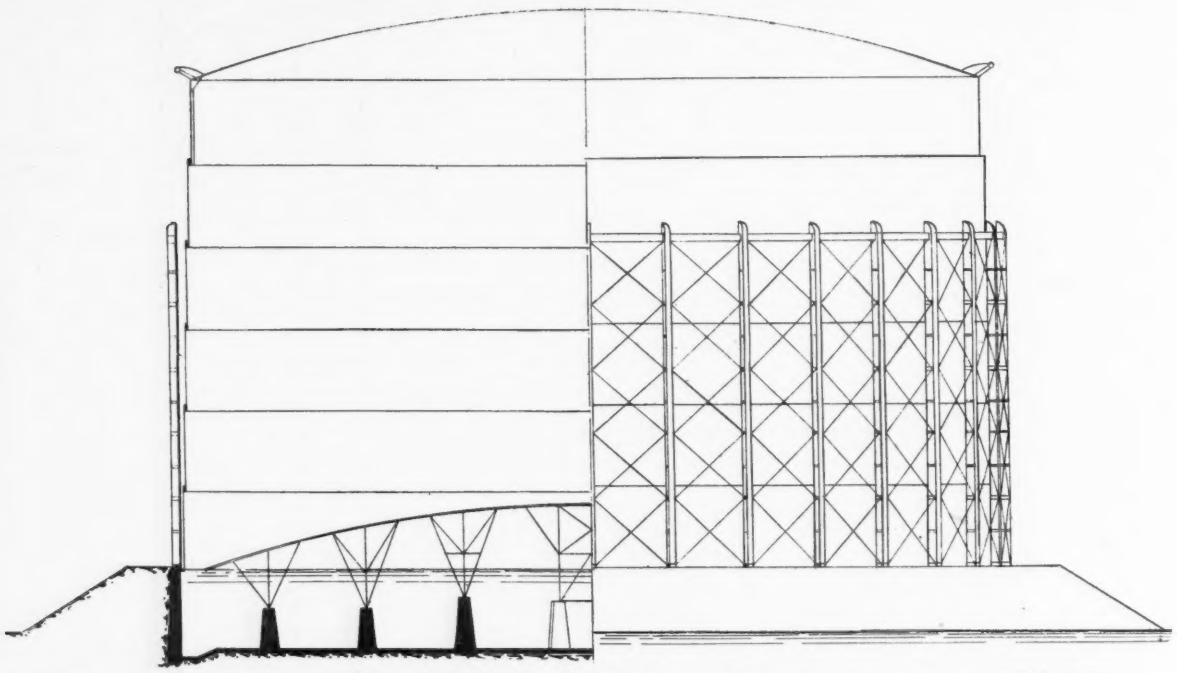


FIG. 5—EAST GREENWICH (SOUTH METROPOLITAN COMPANY) GASHOLDER. CAPACITY 12,111,000 CUBIC FEET.

whereas some years ago 200 times was generally taken as the number. I very much doubt if this development will continue in the same direction and at the same pace. Even in the last few years very little change has been noticeable. Hence we have perhaps arrived at the minimum of holder capacity in proportion to the year's output. It is by no means improbable that gas will still lose some ground as a lighting agent. But then a point will soon be reached where this will not work so favourably on the equalizing of day and night supply, but rather the opposite. If, in addition to this, domestic heating by gas makes a big move upwards, as is to be expected from events in England, more storage capacity will again be necessary. Be that as it may, the proportion of total capital costs of gas-works taken up by the holders is quite small, as is shown by these figures: At a price of 8 mks. per cubic metre [8s. per 35·3 cubic feet], a gasholder of 100,000 cubic metres capacity costs 800,000 mks., is sufficient for the highest day's output of 166,000 cubic metres, and a year's consumption of 40,000,000 cubic metres. The holder therefore represents only about 2 pf. of capital cost [one-fiftieth part of a shilling] per cubic metre of gas sold per annum.

Types of Gasholders.

Naturally the constructors have contributed a large part to these favourable results. I have endeavoured to give you, in the accompanying sketches, a representative series showing the development of gasholders, with a few figures as a basis for comparison. Our holders were worked out on the principle of the large fermenting-vats of brewers. A much later type is the Cologne holder shown in fig. 1, with its wooden guides. Then comes the covered holder shown in fig. 2, which is still in use as a water-tank at the Gitschinerstrasse Gas-Works, Berlin. It has a cast-iron tank and wonderful old-fashioned roof construction. Fig. 3 shows the largest and best gasholder of this type, which the Municipality of Berlin erected at the well-known Tegel works. It is a brilliant piece of architectural work; and, with its great height of nearly 300 feet, it overlooks all the northern part of the capital. The large number of lifts renders a shallow tank possible; but the cost of the tank was high—owing to unfavourable conditions for laying the foundations. It is a curious idea to introduce an oil-store into the tank; but it is hard to imagine a place where oil could be kept with less danger from fire.

The next three holders have bricked-in, half-sunk tanks, but exposed guiding. The Mariendorf holder, shown in fig. 4, has a tank reaching fairly far below the surface water-level in the tank, which was somewhat expensive to construct. No doubt the cheapest of all gasholders ever erected is the enormous one at East Greenwich (fig. 5)—from the designs of Sir George Livesey, well-known as the most economical of gas engineers. Naturally the shallower the tank, the less it costs; but if capacity is to be increased in spite of this, then the diameter of the tank and the number of lifts must be increased. In this case the tank is very wide and very shallow; and there are no fewer than six lifts—the two top ones without any guide-framing. The constructional work of the tank is very weak, since the very solid and almost impervious London clay which surrounds it is able to take off much of the water pressure. The astounding result is that the London holder cost less than half the Mariendorf one per unit of capacity.

But, as far as I know, there are few imitators of this style, which is not likely to find favour with timid spirits. Consider the instability of the whole telescopic arrangement—a shallow disc is much harder to guide than a thin cylinder—and the part of the guiding that is omitted.

Fig. 6 shows a spiral-guided gasholder. This means that on the outside of the lifts are placed spiral-shaped rails, which engage with rollers on the edge of the tank. The lifts screw themselves up and down; so that the rollers, and therefore the tank, have to bear the whole force of wind-pressure, which

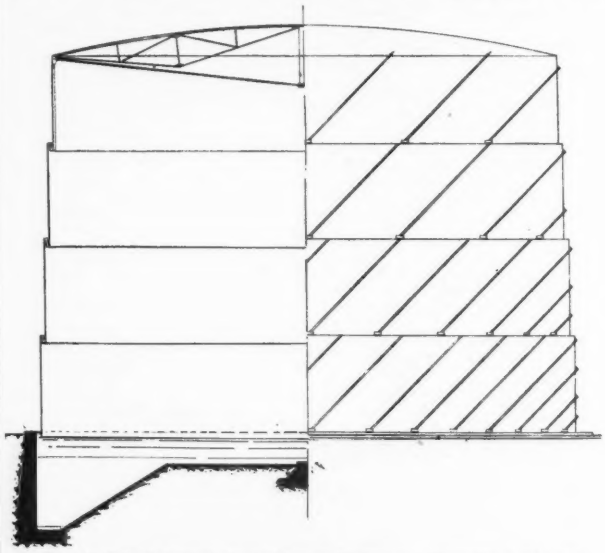


Fig. 6—Spiral-Guided Gasholder at Wallasey. Capacity 1,624,000 Cubic Feet.

naturally renders necessary a strong tank. There is only one holder of this type in Germany, and that is in Altona. Here they have had difficulties, owing to the freezing-up of the rails in heavy frosty weather. Nevertheless, Canada with its severe winters possesses several holders of this type.

In Germany, the adoption of steel tanks above the surface is now almost universal. A good example of this is the Schöneberg holder (fig. 7). Peculiar interest attaches to it owing to its long tale of woe (to which I will return later). The most noteworthy part of its construction is that the wind pressure which works on the guiding-gear is transmitted, not to the tank, but by way of the diagonals in the areas x to the walls of the foundations. The construction of this holder was examined in the utmost detail during the unfortunate legal proceedings; and Herr Müller, of Breslau, succeeded in showing, by the help of an entirely new theory, that, in the supports of the guiding-gear, section a-b, on one side there was a straight iron bar where an angle-piece should have been used. So that there were no very serious faults in the construction.

The measurements and figures of the huge holder of Briggitenau, Vienna, shown in fig. 8, are highly interesting. It is the largest holder on the Continent. The weight of iron used was incredibly small, as was also the total cost; but the duties on iron in Austria considerably augment unit prices.

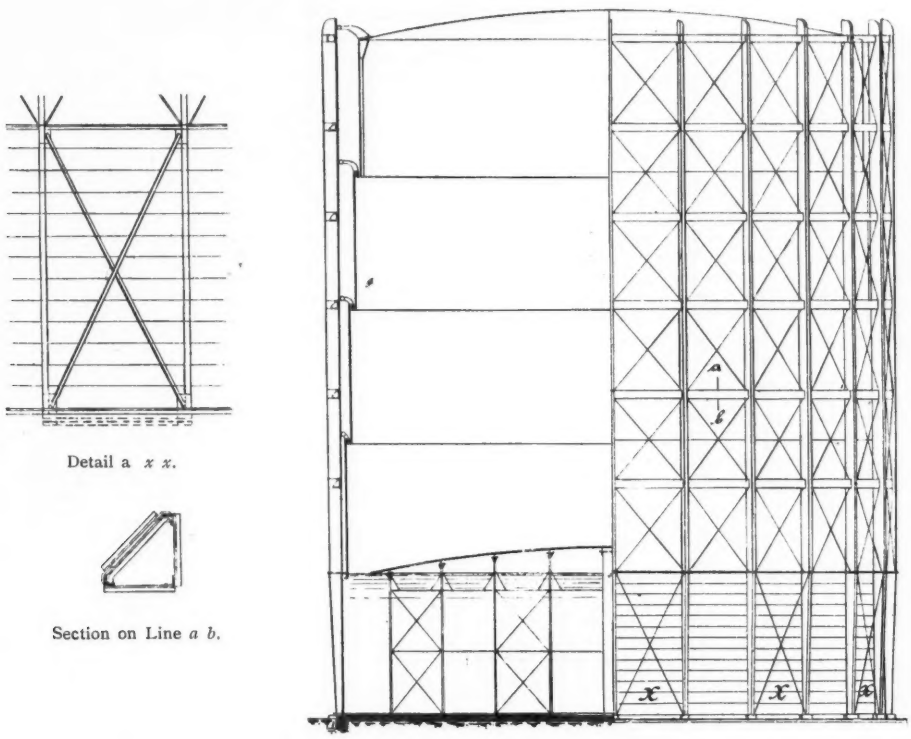


FIG. 7—SCHONEBERG (BERLIN) GASHOLDER; BUILT 1909. CAPACITY 5,650,000 CUBIC FEET.

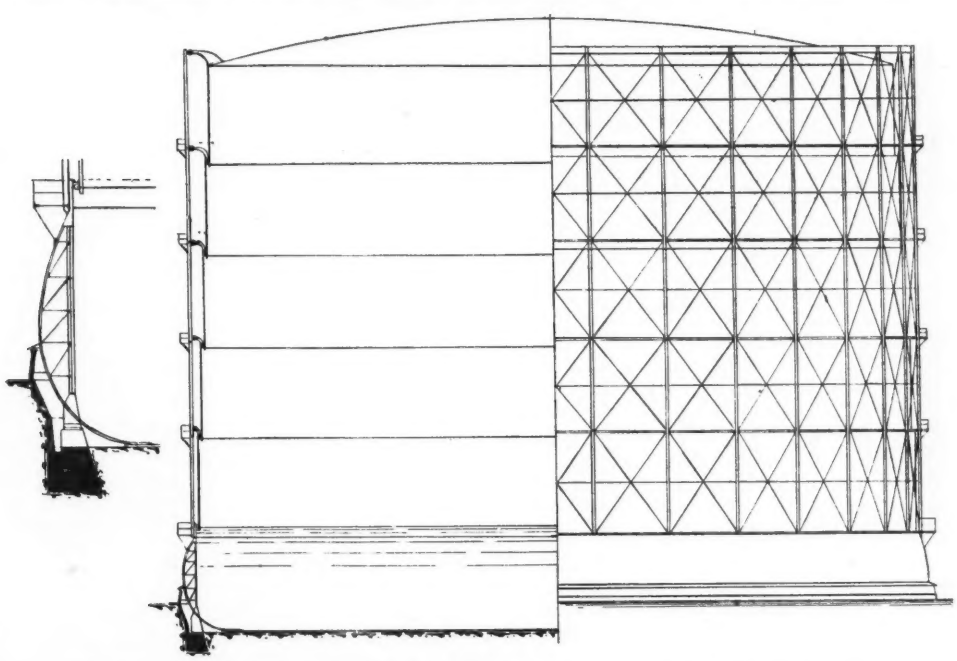


FIG. 8—THE BRIGITTENAU (VIENNA) GASHOLDER. CAPACITY 8,828,000 CUBIC FEET.

I will not now trouble you further with constructional details. With the kind help of a gasholder engineer, I have collected the following information, which may prove interesting.

Practical Hints for Building Larger Holders.

1. It is advisable, with flat-bottomed tanks, to dig the foundations so that they slope evenly up to the centre point to a height of 100 to 150 mm. (4 or 5 inches); so that, when the tank is filled, if there is any sinking of the ground underneath, the bottom of the tank shall not be unduly curved outwardly.

2. The inlet and outlet pipes in the tank and under it are best made of wrought iron. Those under the tank should be firmly cemented in the foundations, in order to avoid the usual pipe channels which are generally full of water.

3. The bottom of the tank should be made of rectangular metal sheets, which at the edge are fastened to somewhat thicker sheets. It should not be less than 7 to 8 mm. thick; and the plates at the edge may be 2 mm. thicker than those in the middle. The circular-cut edge-plates allow of a symmetrical construction of the tank.

4. The fixing of the tank-ring to the bottom is best accomplished by means of two circular angle-pieces, which are best adapted to the transference of the weight of the ring and the guiding-gear to the foundations.

5. Through the expansion of the tank-ring under the load of water, contracting and expanding stresses are also introduced into the joining seams, so that the joints must be carefully fish-tailed. The lower joint of the tank-ring is relieved of weight by its connection with the bottom. The sheets are thereby prevented from joining in the expansion of the ring, which causes bending stresses in the plates. These secondary stresses can be estimated if it be assumed that the ring of the tank is fixed rigidly to the bottom. Then there are high expanding stresses, which amount to one-and-a-half times the tangential contracting stress. In no way is there now an expanding stress, as has been shown by measurements taken on the bottom seam during the filling of a big tank; and so the displacements that really occur are much smaller than can be expressed mathematically.

6. Of late a special material has been employed for the ring-plates of gasholder tanks, which is 30 per cent. stronger than ordinary ingot-iron. These sheets are called high-quality ingot-iron (steel) plates, and the foundries guarantee a tensile strength of 5400 kilos. per square centimetre (76,800 lbs. per square inch) with 18 per cent. extension. Each sheet is put to the test both longitudinally and latitudinally; so that the quality of the material

is quite reliable. The joining of these plates is best effected by double rows of fish-joints of ordinary quality iron, so arranged that for every metre of height the breadth of the plates is only reduced by one rivet hole—94 to 96 per cent. of the breadth thus remaining for use. The use of these special iron plates and the careful joining of them renders it possible to utilize in large tanks comparatively thin plates, which are easy to rivet. Thus a tank of 74 metres diameter and 11 metres deep [243 and 36 feet] was erected in Charlottenburg with 28 mm. [0·09 inch] plates. As plates of 40 mm. thickness have already been used, it is now possible to build tanks of much larger diameter than hitherto.

7. Under the bottom of the tank it is as well to introduce a wrought-iron support; and at the top edge overflow pipes, the ends of which inside the tank should be brought as near the bottom as possible, in order that the longest standing water flows over first. To guide the lifts, strong rails are fixed on the water side of the tank, at intervals of 4 to 5½ metres [13 to 18 feet]. There are generally twice as many of these as of main guides.

8. The guiding-gear must be so arranged that the plates of the tank-ring are not affected by its weight. The bottom part of the guides can be joined to the tank, but in such a way that all the circular seams are exposed, and can be inspected and painted when necessary.

9. Of particular importance is the top edge of the tank, which should at the same time serve as a path for the use of workmen. The rigidity of the top curb must be such as to allow of exact shaping of the edge of the tank, and it must also be able to take up any stresses caused by the wind.

10. The guiding-gear, as is known, is formed of vertical, horizontal, and diagonal bars. The verticals serve at the same time for the guiding of the top lift, and vary in breadth and arrangement according to whether the guiding is to be tangential or radial. The joining of the guides with the horizontals and diagonals is made with big strong bolts in such a way that the forces to be transferred from the diagonals to the lattice-work and verticals shall run as far as possible through the centres of gravity of the horizontals. The horizontal girders are generally so arranged that, when the holder is fully inflated, there is one on a level with the top of each cup; so that from there the cups, rollers, &c., can be inspected. It is best to carry right to the tank foundation any stresses caused by the wind—as was done at Schöneberg on the advice of Herr Bernhardt. But there are a good many holders in which the diagonals extend only as far as the top edge of the tank, and from there the wind stresses are taken up by the plates of the tank. This at times means extra work for the plates.

11. When there are several lifts, the gas pressure on the various works apparatus is an important consideration. The water-seals of the apparatus must be high enough for the heavy pressure of the holder. The pressure for four-lift holders varies from 260 to 400 mm. and more, according to the dimensions. Therefore special attention is directed to water-seals of apparatus. In order to lower the pressure, the roof of the inner lift is often constructed without trusses, and, when the lift is in its lowest position, the roof rests on a special support at the bottom of the tank. This reduces the pressure by some 30 to 40 mm. water-column. But in most cases the weight of the supporting frame is greater than that of the ordinary truss, and it is also more expensive.

12. A very important part of the inner lift is the top curb, which must be so constructed as to take up the stresses on the roof plates occasioned by gas pressure. The curb must therefore be not only of the necessary thickness, but the arrangement must also be such as to give a high moment of inertia, for complete safety against collapse. Likewise the stress between roof and sides must be sufficient to prevent the curb buckling-up. The crown should in all large holders be riveted in double rows, because it is here that stresses change and vary most. Moreover, it is the part of the holder most difficult of access, and leaks and losses of gas can easily pass unperceived there for long periods. The walls of the lifts are constructed of plates 2½ to 4 mm. [·008 to ·01 inch] thick. These plates are kept rigid by framework of vertical struts. They are generally riveted to vertical strips of somewhat thicker metal sheeting, and at top and bottom are riveted direct to the stronger cup and curb sheets. The inner vertical stays or stiffeners of the walls serve at the same time the purpose of guide-rails, on which work rollers fixed to the bottom parts of the lifts. By a suitable joining of the vertical stays and the horizontal bottom of the cups, the most rigid angle-joint possible can be easily effected.

13. The cups are now always made of U-iron. This is bent when cold, and shaped to have exactly the same radius as the lift which it is to fit. The rollers are fixed to the upper cup, at the same time making a rigid joint between the cup and the plates of the holder.

14. For guiding the inner lift, radial or tangential rollers are used, or very often both; whereas the other lifts have mostly only radial rollers. The tangential system applied to the latter is theoretically and practically not advantageous, owing to the tendency of the rings to give.

15. In order to be able to control the rollers, the heating, the water-level in the cups, &c., during working, without any danger, it is advisable to provide each cup with a handrail and stepping platform, so that, whatever position the holder is in, access can be had to each of the cups by means of ladders. This arrangement increases the weight of the holder by only very little; it is out of all proportion to the advantages of the system. The same applies to the crown, on which a handrail is already enforced by law. It may happen that, when a holder remains full of gas for some time, the water becomes low in the cups through evaporation, and the water-seals are opened. This can be avoided by regular inspection, and by having water laid on, so that the cups can be easily filled when necessary. It is almost advisable to have an indicator to show the height of the water.

16. The inlet and outlet pipes should be as far as possible apart, so that the gas on entering the holder does not immediately pass out again. Various inventions have been made known to ensure the mixing of the gas in the holder. In one of these the gas is conveyed straight to the top of the holder, and some way below the crown is another stage, perforated with small holes, through which the gas has to pass slowly. Another arrangement is such that a thin sheet of metal rests on firm props above the surface of the water; the inlet pipe being above the sheet, and the outlet pipe below it. The fresh gas which comes out in the middle of the holder circulates properly and then passes by the edge of the metal sheet to the outlet pipe. Yet another idea is to draw out gas from the top of the holder and force it back again with great velocity by means of a bladder situated outside, thus causing a rapid circulation of gas inside, and enforcing a proper mixture.

Gasholder Costs.

I would now call your attention to the accompanying table showing the costs of the gasholders I have taken as types. The variations in the weight of iron and costs of the various constructions are very striking. Taking into consideration that the foundations, the material, and such additions as the oil-store in the Berlin holder are no small items of cost, it is obvious that certain forms of construction have a very great advantage over certain others. It is worth, therefore, doing all we can towards economical construction, and we all know that much has been done in this direction. But, gentlemen—and this is the crux of all my remarks—there are tombstones on this road to cheapness: Hamburg, Ilkeston, Vienna. Let us consider whether the way we are accustomed to wander is free from all objection.

Description of Gasholder.	Capacity.	Weight of Iron-work.	Total Cost.	Cost per Cubic Metre Capacity.
	Cub. Metres.	Tons.	Marks.	Marks.
Berlin—Tegel	225,000	1,810	2,136,000	9·50
,, —Mariendorf . .	150,000	1,693	1,260,217	8·40
London—East Greenwich	343,000	2,186	1,277,400	3·72
Wallasey	46,000	520	286,000	6·22
Berlin—Schöneberg . .	160,000	3,454	1,156,000	7·23
Vienna—Brigittenau . .	250,000	26,385	1,337,582	5·35

Talking of Ilkeston, Sir Corbet Woodall, the leader of the English gas industry and the "spiritual father" of large gasholders in general, has already raised his voice of warning. Researches showed that the tank was not sufficiently strong. Why, asks Sir Corbet, did the manager there construct on his own responsibility? Why did he not take the advice of an experienced engineer? Such matters are very singularly arranged in the United States of America, as I personally was able to observe quite recently. There reference is not made to a consulting engineer, but to one or two large gasholder contracting firms, which enjoy general confidence. The head of one of these, which erects 70 to 80 per cent. of all holders built in America, said to me: "We only supply heavy, solid constructions at a good price, which gives a fixed profit. If any one else offers a much lower price, he immediately arouses suspicion, and his chance disappears entirely." This permanent state of affairs, which certainly is not conducive to the introduction of improvements, is naturally an excellent protection against flimsy construction. But it is only possible because the industry is almost entirely in the hands of private companies. The engineer of such a company can say to himself: "I prefer expensive and solid construction." But managers of municipal concerns are accused of extravagance at the public expense, if they refuse lower tenders. Competition drives the contractors to resort to the limit of light construction. No doubt many improvements are effected under such a system; but where is the control? Very few towns possess an office which can deal with specifications for such a special construction as a gasholder; and the Berlin Police Building Department will not undertake it. Who is to take the responsibility? Morally, no doubt, the Council, who have given out the tender; but they are in no way qualified to do so. My point is that, if the present methods of tendering are to continue, the only way out of the difficulty would be to employ the services of a first-class engineer and mathematician, to test everything thoroughly, and insist on a good factor of safety.

In my own province, I have recently had like experience. At the Weissensee works a bridge used for coal trucks collapsed. I have since learned that the tenderers for this kind of construction haggle for every 100 kilos. of iron. Had I consulted sooner the man who now advises me on such subjects, I should have been spared much expense.

The Schöneberg Gasholder Trouble.

Herr Körting continued with a summary of the unfortunate events connected with the big Schöneberg holder. He described how it was planned to be erected in the middle of a populous

district, so as to help in the supply of gas to over 100,000 inhabitants. The plans were passed, and the erection commenced. Owing to an accident to one of the contractor's cranes, the building operations could not be completed within the specified time. It is usual in such cases for the local authority of the district to grant an extension; but this, unfortunately, happened at the time of the Hamburg gasholder disaster. In view of the serious nature of the latter, the Company feared an extension of the time-limit for construction might be refused; and it can well be understood, the author said, that they hesitated in making the application. There was at the time considerable difference of opinion in Berlin as to whether a concession once given could be withdrawn. After much discussion, and the taking of legal advice on the subject, the Company continued the erection of the holder without applying for an extension of the time-limit; and the work was completed without any interference on the part of the authorities. After this, Herr Körting was sued by the Public Prosecutor for completing a building without permission, and was fined 3s. or one day's imprisonment. By this judgment, the Company were placed in a most uncomfortable position. The Hamburg disaster was at the time not forgotten; the holder stood there at its full height; and the concession was lost. The populace stormed against it in the press, in meetings, and in petitions to the ministry.

Next the actual constructional details of the holder were subjected to examination and criticism. One expert declared that the holder must collapse in any strong wind, owing to there being no internal horizontal support—forgetting that there would be the pressure of gas inside, which would be far greater than any possible wind stresses. The gentleman in question turned out to have been an expert on road-making and stone bridges. But he succeeded in thoroughly frightening the inhabitants of the neighbourhood. Fortunately, nothing had been spared in perfecting the ironwork of the construction. Another contention was that the holder was a violation of the law which protected "beautiful landscapes" and town districts against being marred in any way. But this objection was refuted by the opinion expressed by the eminent architect, Professor Möhring. He remarked that the gas-works were placed in the best possible spot for the purpose—one which would have been useless for building. If the neighbourhood was an unpleasant one, it was owing to the tremendous train-service, and not to the gas-works. The increasing population demanded an increased gas supply; and it was now no longer possible for the Gas Company to construct a holder which would blend with the general landscape. A comparison of this holder with the older ones would, he said, show that it was after all a vast improvement. So much was said of æsthetics; but really there was something truly æsthetic—almost romantic—about the architure of this "stately, clear, and peaceful" construction. It could not possibly mar the appearance of the whole city, because, as a matter of fact, it was visible from only a very few places. It was argued also that so many houses would be overshadowed and hidden away. But one glance at the hideous houses in question would convince anyone that this was the very best way of treating them. So far from the holder spoiling the appearance of the neighbourhood, it might be said that the "clear-cut, stately construction" lost much in appearance from its surroundings. The only adverse criticism of Professor Möhring was that the holder should be painted a more agreeable colour.

Above all things, continues Herr Körting, people were opposed to the great height of the holder. I must confess that my ideas in this respect have undergone a complete change since my recent journey to America. Especially in New York, I was impressed by the charm and variety imparted to a city by high buildings. And in New York the size of the gasholders is in keeping with that of the houses. Compared with the sky-scrapers over there, our Schöneberg holder is almost liliputian. It might be said that such a fine erection gives a better idea of the modern technical development of a city than rows of dull, symmetrical houses. Other objections were brought on grounds of hygiene. It was argued that the height of the structure would deprive the neighbourhood of light and air, and that in the evening a shadow would be cast over the whole city. This is not to be wondered at, because it is obvious that at sunset all shadows are indefinitely prolonged. It was proved by so-called authorities that smoke would collect on one side and then wander down the other. In fact, there was no nonsense so gross but it was wrapped in a cloak of wisdom and brought forward as evidence.

One of the weak spots in our case, if not the weakest, was the danger of fire suggested by the Hamburg disaster. In this respect, our opponents hit on the bright idea of bringing forward the fire brigade as experts. In such a case, a certain number of experienced members of the brigade are assembled; and, upon this occasion, they expressed a very carefully considered opinion. Referring to possible danger of explosion, they stated that it was impossible for an explosive mixture to be formed inside the holder, since such a mixture is only formed when the proportion of gas to air is 1 : 15 or 20. When the holder is down to the lowest level, only the inner lift contains any air. If the holder be inflated with gas from this position, without expelling this air, then it is obvious that the gas will be far in excess of the air. But, as a matter of fact, when the gas inlet is opened, escape pipes in the inner lift are left open until no more air passes out; and then they are closed, with the result that the holder contains pure coal gas. Slight knowledge of gas-works practice shows that after this nothing but highly purified coal-gas passes in, except by some quite extraordinary accident. Should the holder become leaky, the pressure it gives will cause gas to stream out, and absolutely prevent any air entering. If the gas streaming out should (from lightning or any other cause) be ignited, it will burn harmlessly away until the holder is empty. Leaks in the tank can be immediately detected by the water flowing out, and can be stopped without trouble, or the gas supply be turned off. Moreover, they are quite harmless unless within 30 cms. from the bottom; for the bottom of the outer lift cannot rise above this point, and the first 30 cms. of the tank from the bottom are so strongly protected that damage to them is highly improbable. If the water should sink below this level, gas will pour out so fast as to prevent any likelihood of the formation of an explosive mixture. But should such a mixture, by any extraordinary chance, be formed, and also ignited, an explosion would occur, but in the open would be comparatively harmless. An explosion inside the holder is, however, quite out of the question.

The dangers from fire can be divided under two heads: The danger to the gasholder from fire in its vicinity, and danger to buildings and stores of materials from a possible fire on the gasholder. On the first point, the fire brigade reported that there was no danger at all. The large volume of water contained in the tank put out of the question any danger of neighbouring conflagrations overheating it. There were also no buildings or anything near of such a nature as would burn to such a degree as that, and none of them would present any difficulty to the fire brigade in their efforts at extinction. Any heating of the lifts of the holder was inconceivable; but, as the gas is manufactured at a temperature of 1100° to 1200° C. without burning, even if the holder was brought to a white heat, there would be no danger to the gas enclosed. It would merely expand, and force its way out through the water-seal of the tank, and there burn or pass harmlessly away, as described above. But the great height of the holder, and the distance of the buildings surrounding it, put all this in the region of pure imagination.

On the second point they remark that, if gas issuing from the holder were ignited, it would take the form of a jet flame, owing to the great pressure on it. So long as this shot out horizontally, it might injure the buildings on the gas-works, but could not possibly reach farther. As a matter of fact, the flame would heat the air above it more than the air at the sides, and so would in a short time be directed upwards, and out of danger, The bigger the opening from which the gas issued, the shorter would be the duration of the conflagration, but the more harmful the flame.

In their summing-up, they came to the conclusion that the only possible immediate danger was to the other buildings on the gas-works, which would be of no more importance than any fire in the district, and that there was nothing against the use of the holder, provided it was filled with pure coal gas.

End of the Dispute.

These objections, such as they were, were brandished with a tremendous amount of words, and of pen and ink. The local authorities tested everything with a great show of wisdom; made personal visits to the works to see the effect of the holders when inflated; and asked the opinion of such high authorities as Dr. Bunte. After much deliberation, they came to a definite decision, and granted the concession unconditionally.

An appeal to the Minister of Commerce and Industry was still left; and this was at once lodged by the people of the neighbourhood. His decision of April 12 of this year was also entirely in favour of the Company. In giving his opinion, the Minister expressed precisely the same views as those of Professor Möhring—that, from all points of view, it was rather an improvement than otherwise to the appearance of the district. To assert that it would deprive the neighbourhood of light and air was absurd. It was true that smoke could collect on one side of it; but this was even more so with an ordinary square building than with a circular erection. Any objections on the score of explosion or fire had been dispelled by the report of the fire brigade; and the Hamburg disaster had been due to mechanical causes, which in this instance did not in any way apply.

The only remaining plea against the solidarity of the construction was that of the Magistrate of Schöneberg; but this could not be sustained. It was, moreover, complained of the holder exceeding the maximum height allowed by the police regulations for buildings. But since the local authorities, in first granting the concession, had not considered it in the sense of an ordinary building, and since its actual height was continually changing, this objection could not be upheld. The Ministry could, therefore, see no reason for reversing the decision of the local authorities, or for ordering, as had also been suggested, that the holder might only be half-filled, nor that gas making should be stopped at Schöneberg and the holder only filled from Mariendorf.

Herr Körting concluded by remarking that the whole proceedings, from the completion of the holder, had occupied about three years. It was most fortunate that the Company eventually received the support of the local authorities. But it was really hard, when a big and useful piece of work has been accomplished, to find that it is a thorn in the flesh of the very people whom it is intended to serve. But one must have the good sense not to be so obliging as to do away with useful works, just because certain classes of men take up certain standpoints which, with the best consideration and kindest treatment, can only be regarded as far from correct.

GERMAN ASSOCIATION COUNCIL ANNUAL REPORT.

The following is a summary of the report of the Council on the work of the Association during the past year.

It was unanimously agreed at last year's meeting at Munich that, among steps to be taken for strengthening the financial position of the Association, the annual contribution payable by corporate bodies (as distinct from ordinary personal members) and extraordinary members should be raised from 15 marks to 40 marks (£2). This step had resulted in the receipts from subscriptions of all classes being nearly doubled. The expenditure of the Association had, however, increased; and the new measure was fully necessary to ensure the work being continued without strain on the resources. Unfortunately, contributions to the widows' and orphans' fund of the Association had shown a decrease as compared with previous years.

Many important questions had been dealt with either through the District Associations or by members. The Mid-Rhenish Association were engaged in investigating whether economy would ensue in the use of apparatus for lighting, heating, and industrial purposes, if gas were supplied generally at higher pressures. It was a question in which advantages were offset by disadvantages; and ultimately it would have to be decided to what extent pressures could be raised with advantage, and whether a change should be made gradually or at one step. The same District Association had raised a question as to the relative advantages of cast-iron and wrought-iron gas-mains, in view of an attempt on the part of the Mannheim Magistracy to prescribe the use of one to the exclusion of the other. It was decided that the choice of material must be determined solely by the particular conditions of each case.

The Rhenish and Westphalian District Association had raised a question as to whether wrought-iron and steel pipes could not be made with the outer diameter equal to that of the inner diameter of cast-iron pipes, in order to get over the difficulties which occurred in using the two descriptions of pipes together, when both were made to the same size inside. With the smaller sizes, it is often possible to work in with cast-iron pipes the wrought pipe of the next larger size; but with the larger sizes, this is out of the question. Inquiry of the makers elicited the fact that most of them would be willing to make wrought-iron pipes of the same outer diameter as cast-iron pipes, if only there were a sufficient demand for them.

Two members suggested that an agreement should be arrived at that certain signs and colours should be used universally in all plans of mains. There is uniformity in this respect in plans of electricity distributing systems, &c., but not in plans of gas and water mains. It is a question whether the German Association of Engineers might not act in collaboration with other technical bodies to secure general acceptance of signs already recognized by it. The Rhenish and Westphalian District Association have also inquired whether it would not be possible to standardize the parts of lamps and burners, in order to overcome the difficulty experienced, owing to the continual changes which are being made, in replacing parts. This matter was referred to the Photometric Committee for consideration, with a suggestion that the manufacturers of lamps should be consulted in regard to it.

A German Society for Studying the Technical Aspects of Questions of Illumination was founded in Berlin on Nov. 2, 1912. Its aim will be to secure co-operation among the different lighting interests in the country. The Association of Gas Engineers and the German Electrotechnical Association are each to be represented by six members on the Council of the new Society. The Council will consist of 24 members all told. The "Journal für Gasbeleuchtung" is to be one of the official organs of the Society, which already has 85 members connected with the gas industry. Another new Institution is one founded at Mülheim, on Nov. 4, for the Investigation of Coal. The work seems likely to be of interest to gas men; and the programme issued shows that it is studying coal from a broader standpoint than the experimental works of the Association at Carlsruhe, and that at present the work will not overlap that of the latter institution.

The Association have decided to contribute £25 towards meeting the cost of the preparation of the International Technical Dictionary in six languages, which is being published by the house of R. Oldenbourg, of Munich.

The import duty on mineral oils for use in Diesel engines having recently been lowered, it has been suggested that tar oils for similar use ought to be carried by the State at a reduced freight, in order to protect them from the competition of imported oils. The Council are inclined to the view that, as tar oils are sold at much lower prices, the reduction in the duty on imported oils will not appreciably affect their sale, and that it would be a mistake to take any steps which might tend to prevent water-works obtaining the cheapest possible fuel for the Diesel engines which they use for power purposes. But the Council are strongly of opinion that the reduced import duty should apply to all oil of the same physical properties, irrespective of whether it may be used in Diesel engines or for some other purpose—*e.g.*, carburetting gas. Statistics show that German gas-works now consume 15,000 tons of gas oil per annum.

A valuable piece of work, which has been in hand during the last two years, and in which many technical men, Committees, and District Associations have co-operated, is the drafting of regulations for water-fitting. These regulations, of which a digest will be given on another page, are being submitted to the meeting for approval. It will be remembered that similar rules for gas-fitting were drawn up by the Heating Committee, and presented to the meeting in Konigsberg in 1910. The present water-fitting rules have been carefully considered, even to the smallest detail, by Sir W. H. Lindley, an honorary member of the Association. The discussion of them by the District Associations showed that local conditions would not admit of prescription of matters of detail; and the rules therefore were confined to broad principles, and were made as short as possible. The rules were ultimately drafted by Herr Reese, of Dortmund, and were approved by the Water-Works Committee, and by the Special Committee of the District Associations. The Council therefore anticipate that they will be approved unanimously by the members at the meeting. With the issue of this set of rules, following on the similar set of regulations for gas-fitting, it is hoped there will in future be little friction between undertakings and fittings firms.

The Council instituted in the spring an inquiry as to the chemical purity of German water supplies. Twenty-five years have elapsed since any similar inquiry was made; and the particulars now received show that an extraordinary advance has taken place in the interim in the general recognition of the value of water examination by chemical analysis. It has been found impossible, however, to tabulate and summarize all the particulars received in time for presentation at this meeting.

The Association have been in cordial relationship with other technical associations, and delegates have been sent to various meetings—notably the jubilee celebration of the Institution of Gas Engineers in London [to which fuller reference has been made in our report of proceedings at the annual meeting at Strassburg]. Thanks are given to the members of the various Technical Committees of the Association for their assistance; and reference is made to the work of the Committees during the year. Summaries of the reports of the Committees are given on this and succeeding pages of the "JOURNAL."

The number of members, of all classes, of the Association has diminished by 61 in the course of the year. The loss by death was eight members, and the greater part of the diminution in numbers is doubtless due to the increase in the subscription which has been imposed on certain classes of members.

The report includes detailed accounts of the proceedings during the year of each of the eight affiliated District Associations. A large number of firms and corporate bodies are mentioned as having given substantial donations to the scientific purposes fund of the Association. Report is made of the administration of the Schiele travelling studentship fund, from which payments amounting to £35 were made during the year to three students. The Benevolent Fund of the Association is referred to, and the report concludes with the announcement that the Vice-President who retires by rotation this year is Herr H. Ries, of Munich. [Herr K. Lempelius, of Berlin, was elected to succeed him, in the course of the proceedings on Thursday last.]

GERMAN ASSOCIATION COMMISSIONS' REPORTS

Training and Experimental Institute.

The report of this Commission opens with an invitation to visit and inspect the works of the Association at the University in Karlsruhe—the holding of the meeting in Strassburg affording an opportunity to the members for assuring themselves that the institute was being carried on in the best way, and for acquainting themselves with the interesting and many-sided work.

The department which dealt with coal analysis and distillation had accomplished some excellent work in the course of the year, and had become thoroughly acquainted with the various coals that were used in Germany. To this the results published from time to time would bear testimony. The department which was engaged studying the applications of gas had developed more and more; and in the course of daily work new problems were constantly cropping up. Even if every point was not such as could be laid before the public, yet a mass of experience was accumulating which was helpful to the whole industry as well as to individuals. Questions from practice were constantly being put to them, which they always welcomed, with the wish to make the institute an information centre for the industry. The number of the firms was increasing which submitted their proposals and apparatus for tests. But the constant help and interest of members of the Association were necessary in calling attention to novelties, sending in subjects for tests, and so supporting the institute actively and with good advice.

A most important piece of work, which had taken up far more time than would appear from the mere results, was the collection of rules and standards for testing gas-cookers. They were prompted to this work by the knowledge that a very large number of methods of testing cookers are both possible and actually in use, the results of which are incomparable owing to the different systems of working and making the calculations. Extensive experiments were therefore made on the subject, during which time constant communication was kept up with the Swiss Association Commission on Heating, which was working to the same end.

The results of this work are given in an appendix to the report, which is submitted for approval. The investigations of gas-fires were continued, and besides the reflector fires which are almost generally used in Germany, a purely radiating fire from Wright of Birmingham had been examined, and others with a combination of radiating bodies and heat deflectors from Vienna and Rotterdam. All these showed complete combustion, and even by the most sensitive methods no measurable quantity of carbon monoxide was detected in the waste gases. Tests were further made as to the effects of various flue draughts on the products of combustion. In these experiments the "Shadowgraph" method, recommended by Mr. Butterfield for detection of products of combustion escaping into the room, proved of great service. The heating efficiency of the fires varied between 70 and 90 per cent. Radiation and convection tests could not yet be carried out, owing to lack of apparatus. Geysers and water-heating appliances were likewise submitted to tests, but these are not complete, and no results can yet be published. At the same time examination of gas analysis methods has been proceeding apace, which prove to be of great practical value.

The results of coal analyses have been published from time to time in the official organ of the Association. Needless to say, these results cannot be obtained in actual practice, where laboratory care cannot be exercised. But this need give no cause for alarm, if working results are approximately near. It is of course most important to know exactly the quality of the coal which is being carbonized at any works, and these published results should prove most useful, besides being a check on the coal delivered by the contractors. The institute is also prepared to test any samples of coal sent in by gas managers, with a view to controlling working results, quality of bye-products, &c. Certain coals have also been retested, in order to fill in certain gaps before publication. Mines in the Saar and Mosel districts have been of great assistance in this respect, but unfortunately the Rhine-Westphalian Coal Syndicate has not responded in the same way. Since the tests on these coals were made soon after the founding of the institute, many new observations of great importance have been made. As it was hoped that the gaps might shortly be filled in, the results of these tests had been held back; but they will soon be published. Tests have also been made on other fuels—such as Braun-coal—and most interesting results obtained.

Much more outside work was performed by the staff of the institute this year, and it was often difficult to comply with all requests, without disturbing unduly the work at home. Among other things, important tests were carried out on large furnace installations in Vienna, Mannheim, Pforzheim, Halberstadt, and Würzburg; and other such work is in prospect at home and abroad. Although the preparations and laboratory work attached to this branch occupy a considerable amount of time and energy on the part of those engaged, it is hoped that the institute will be able to carry out all that is asked of it to the satisfaction of those who, in this way, show their complete trust and confidence. The laboratory will still be open to undertake tests of raw material and produce of the gas industry, and to solve problems of troubles experienced in the manufacture and application of gas. The vast amount of correspondence carried on in this way during the past year was most satisfactory, and it is hoped it will continue.

The report concludes with some remarks on the financial state of affairs, and the staff. The balance-sheet is unfortunately less satisfactory than the rest of the report. Expensive apparatus had been tested, and the income from products and bye-products had decreased. The Commission which has charge of the institute had accordingly been forced to take something from the reserve fund, and the Committee of the Association was going to propose that a like sum should be voted annually to the institute as was given to the Gas Publicity Centre.

Regulations for Testing Gas-Cookers.

An appendix bearing this title follows the above report. The regulations have been drawn up in collaboration with the Heating Commission of the Swiss Gas Association, and it is hoped they will be universally adopted. It is naturally useless to speak of the efficiency of a gas-cooker without taking into consideration the utensils used with it.

Heating-up Test.—The efficiency of a cooker is the proportion of the heat units taken up by a certain quantity of water to the total number of heat units employed.

$$W = \frac{q\,(t_2 - t_1)\,.\,100}{g\,.\,H}$$

where W is the efficiency per cent. of the cooker, q the weight of water, t_1 and t_2 the initial and final temperatures of the water respectively, g the quantity of gas used, and H the lower heating value of the gas (g and H reckoned at N.T.P.).

The following are the rules to be observed:

1. Aluminium utensils of cylindrical shape are to be used.
2. The utensil is to be chosen of such dimensions that the area of its base is about as many square centimetres as the cooker consumes litres per hour—*e.g.*, a pot of 12 cms. diameter has sectional area of 115 sq. cms., and may be used for a cooker consuming up to 135 litres of gas per hour, &c.
3. The utensil is to be filled with special quantities of water according to its size, thus:

Diameter. Cms.	Quantity of Water. Litres or Kilos.	Diameter. Cms.	Quantity of Water. Litres or Kilos.
12	0·6	20	2·5
14	1·0	22	3·5
16	1·5	24	4·5
18	2·0	26	6·0

4. The test is to be carried out in a room free from draughts, and lids of utensils must be closed tight, and a thermometer inserted, packed tight.
5. The test shall begin with the cooker at room temperature (about 20° C.).
6. The water shall be heated from exactly 20° C. to exactly 95° C.
7. The burner is to be worked at a pressure of 40 mm. (1·57 inches) water-gauge, measured at the inlet.
8. The heating value of the gas must be within the usual limits (18,000 to 20,000 B.Th.U.), but should be determined for each test.

Continuous Cooking Test.—This is to determine what amount of heat is required to cover loss from radiation and convection of cooker and utensil. The gas supply must be so regulated that the water remains constant at a temperature of 95° C. during the whole test. The test is to last an hour, and the quantity of water used is the same as in the other test. The quantity of gas used is multiplied by the lower heating value to find the number of heat units used. All measurements to be reduced to N.T.P. This number of heat units is then given. For absolute accuracy, the weight of water lost by evaporation may also be found. The heat of evaporation of this quantity (about 2090 B.Th.U. per gramme) may then be deducted from the number of heat units used altogether.

Some explanatory remarks are added. Aluminium was chosen as the material for the utensils, because it gives the most constant results with varying thicknesses. Cylindrical shape is recommended as being the most convenient; and the proportion of depth to diameter should be about 2 : 3. The utensils mentioned are of such dimensions as are most easily obtainable, and the time needed for heating-up their contents is 12 to 20 minutes. The quantities of water suggested are such as to fill the utensils about two-thirds full, if the latter are of the proposed proportions. The utensil must be tightly closed, and the thermometer fit tight in its place, or considerable losses will occur through evaporation. Stirring of the water during the test is not necessary, as there is enough agitation when a temperature of 80° to 85° is reached. Care must be taken that the cooker is cold at the beginning of each test, and if cooled with water, it must be dried carefully. An initial temperature of 20° C. is chosen, because water at this temperature can be obtained even in the hottest summer. Above 95° C. the vapour tension is so great that considerable losses by evaporation are hard to avoid; hence the test should stop at 95° C. The gas pressure must be watched carefully, as it influences the consumption, upon which depends the size of utensil.

Gas-Works Control.

Circulars were sent out by this Commission every month through the Gas Publicity Centre, asking gas-works for their working results. As replies had been received from works covering about 85 per cent. of the total output of the Empire, the statistics issued, which are included in the present report, can be taken as giving a fairly general survey of the industry in Germany. The increase of consumption is obvious, and the growing number of meters in use indicates the addition of new consumers; while the success of the prepayment meter far exceeds the most sanguine hopes formed of it. At the same time, the opportunity was taken of addressing to the works questions of general interest. One such question was: "Do you undertake outside gas-fitting?" Of the 563 replies received, 372 were in the affirmative, of which 275 were from works under municipal control. In 27 cases the gas-works have a monopoly of gas-fitting. Fitting is undertaken in 45 cases at the express wish of the consumer only. Installation prices are fixed in the case of 19 works by local legislation. To the question whether air is added to the gas with the object of revivifying the purifying material, answers came from 150 gas-works. Several works had given up the system—one on the advice of a meter maker; another because nitrogen seemed to be harmful in low-lying parts of the district; another because injuries to meters were attributed to the addition of air. Several works only add air when water gas is not being used, but there is one case of exactly the opposite idea. Some add the air only in winter. An example is quoted of caking of the material and loss of pressure being attributed to air. Most of the works which sent replies add the air just before the purifiers, only a few immediately after the hydraulics. The average amount added is 1½ to 2 per cent., only a few works going up to 3 per cent.

Statistics taken in August of last year gave the following figures for meters:

Ordinary Meters.	No.	No. of Works.
Dry	1,538,989	541
Wet (water)	1,002,443	265
Wet (oil)	7,079	50
Prepayment Meters.	**No.**	**No. of Works.**
Dry	301,375	401
Wet (water)	175,069	23
Wet (oil)	23,752	17

Replies to the question as to what percentage of all households were supplied with gas were hard to obtain; satisfactory answers being received from only about one-third of those asked. Taking an average of 25 districts given in the report, only 45 per cent. of the total households are being supplied with gas. The variations in some districts are remarkable. In Brandenburg, for instance, the best neighbourhoods have a percentage of 85 consumers; the worst, only 7·6. The figures, although by no means comprehensive, indicate that there is still plenty of room for the expansion of gas consumption. A further question was put to gas-works regarding the rental levied on meters. In 27 instances there is absolutely no further charge for meters, several works indicating that this has done much towards increasing the consumption. Some undertakings only make no charge for power-gas meters, others for cooking-gas meters. In 15 instances the meter is only

charged if the consumption does not reach a certain figure. The rents vary from 1s. to 6s. yearly for quite small meters, and from 1s. 2d. to 36s. for large 50-light meters. In some cases the consumer still has to purchase his meter, but this does not seem to be the right principle, for difficulties occur when the meter is no longer fit for use, and the gas company requests the consumer to purchase a new one.

Photometry.

This Commission had presented no report at the meeting of 1912, and also no request for re-election, and was therefore considered as dissolved. Its work however was carried on by a select committee of four, chosen from among the members. The subjects they intended to consider were: (1) The working out of new regulations for measuring light, and especially the reconsideration of the measurement of spherical illumination. (2) Preparations for fixing international units of photometrical measurements and their naming. (3) Experiments for finding a reliable method of testing the strength of mantles. (4) Testing of lamp-systems, especially high-power lamps, with a view to a universal naming of the various types.

In the autumn of last year, however, the Committee entered on a new and highly important task—viz., active co-operation in the foundation and organization of the German Illuminating Engineering Society, which was given the prominence over other work, though this was not neglected. At a meeting held in November, they considered the rules of the new Society, the American proposals with regard to international photometrical units, and measurement of street lighting. On the same day the inaugural meeting of the Illuminating Engineering Society took place, and the four members of the Photometric Committee represented their Association at it. They met again in February, when they decided to consider the adoption of normal measurements for lamp-parts, and to propose rules for the intended International Illuminating Engineering Commission. On Feb. 24 the Commiitee attended the first annual meeting of the German Illuminating Engineering Society, where they watched the interests of the Association as regards representation on the General Committee and the special commissions appointed. Besides the work already mentioned that the Select Photometric Committee have in hand for the coming year, they offer any assistance they can give in calling together the Proposed International Commission.

Gas-Meters.

The activities of this Commission were devoted during the past year to the two subjects carried over from the previous twelve months—viz., a reliable membrane for dry meters, and proposals for uniform external dimensions of wet and dry meters. In both cases the experience already gained, in many instances of a negative order, was of great assistance in furthering the objects of the Commission, if not in completing them. Information was supplied to inquirers on many subjects, chiefly with regard to the imperfect working of meters, premature perishing of the leather membrane, balancing of repair expenses for meters that did not last out their guarantee period, &c. A meeting of the Commission was held on May 8 of this year, and a conference was held in Cassel in April in conjunction with the Committee of the Meter-Makers' Association. Much useful assistance was obtained from the Imperial Testing Commission and their representatives.

The membrane used in the experimental meters Va. 1910 was found to be gas-tight; it was not affected by oil deposits, but the liquid which separated out of the gas was inclined to shrink the tissue, causing an error on the *plus* side. Therefore another material had to be found, which, in the unprepared state, did not vary in size after repeated moistening and drying. The stuff now chosen has been worked up to a membrane by a linseed-oil process very much resembling that used by the Official Commission; and it is to be called Mb. 1912. G. The thanks of the Commission are expressed to the Mainz Meter-Works for fitting up several meters at their own expense with a new membrane for trial, and distributing them to the Official Commission and various gas-works, to be tested in continuous working. The Commission cannot yet report in great detail on this new membrane, Mb. 1912. G. But the first meter fitted with it, working from November to April, and measuring about 100 cubic metres of gas at half and full flow, showed only very slight variations from its initial tests. The Official Commission have tested it by passing separately dry gas and air, and gas and air with similar proportions of moisture. The effect of the moisture was slight; but the membrane was found to resemble the previous one in that a change from air to gas caused slight shrinkage—the maximum variations with five-light and ten-light meters being 3·8 and 4 per cent.

The aim of the Commission with regard to dimensions of meters was made known last year. They wish to make uniform in meters of like capacity such measurements as the height, the distance between inlet and outlet, screws-threads, &c. It was found that the measurements suggested in the report last year would lead to difficulties. Accordingly inquiries have been made during the year from a number of firms, and a new set of measurements proposed on the basis of their suggestions for all sizes of meters. The new measurements are not necessarily averages, but are suggested by individual types and on the advice of large consumers—the Commission considering that it would be easier to increase the measurements of small types than *vice versâ*. The Commission think it unwise to make any proposals as to the size of meter-casing. The makers themselves have expressed a desire for uniformity; and the only question seems to be to what extent proposals should be made. Considerable importance attaches to dry meters, in view of their increasing adoption. But proposals for them are difficult to make, as their main measurements show more variations than those of wet meters. The variations in screw-threads at present are great; and special suggestions have been made, the adoption of which would be a simple matter, and quite a big stride in the right direction. The table of proposed measurements has not been included in this report; but it has been sent to the Committee of the Meter-Makers' Association for distribution among their members, who will thus have an opportunity of examining and criticizing the proposals.

Water-Works Control.

Difficulties were placed in the way of this Commission in the shape of an insufficient sum of money being voted to them at the last meeting of the Association. It was eventually decided that they should reduce the scope of their annual statistics of over 400 water-works, issuing a full report every five years only. Besides working on their statistics, the Commission devoted their attention to the question of the installation and alteration of water-supply systems, as proposed at the Munich meeting last year. The results of their work in this direction had been embodied in a formal report, which they submitted to the Association for official adoption.

COKE-OVEN GAS SUPPLY IN FRANCE.

At the recent Meeting of the Société Technique, M. Chanial submitted a paper in which he described the arrangements for the conveyance of the coke-oven gas manufactured at Roche-la-Molière to the gas-works at Firminy for the supply of that town and Chambon-Feugerolles, both in the department of the Loire. The following is a translation of the principal portions of the paper, which was of special interest by reason of the fact that it referred to the first case in France of the conveyance of coke-oven gas to a distance.

Introduction.

The two towns of Firminy and Chambon-Feugerolles, in the department of the Loire, are of some importance. The population of the former is nearly 20,000, while that of the latter, including the town and the places through which the mains run, is 12,000. There are consequently 32,000 inhabitants to be supplied with gas. Unfortunately, the consumption is small, and not in proportion with the population. They are working class towns, where the factories generally provide their own lighting by electricity, and the workmen have hitherto been strangers to the use of gas in their homes. Consequently the production of the gas-works hardly exceeds 35½ million cubic feet per annum; while the consumption is much below this. Further, the leakage is heavy, owing to the district being a mining one, where there are subsidences of the soil. However, at the expiration of their concession at the close of 1911, the Firminy Company, who formerly sold gas at the rate of 25 c. per cubic metre (5s. 8d. per 1000 cubic feet) found it necessary to reduce the price considerably, following the example of the neighbouring town of St. Etienne, which had made a fresh contract. The Company were led to fix the figure at 16 c. per cubic metre (3s. 7½d. per 1000 cubic feet), without reckoning other great advantages accorded in respect of workmen's houses.

The Firminy Gas-Works, which were already old, had reached their limit of production, and yet there was reason to expect a great increase in the number of consumers on account of the reduction in price. It was then that it was decided to accept an offer made by the Roche-la-Molière and Firminy Mining Company to supply gas from their coke-ovens recently built at the first-named place. This is the plant which the author wishes to bring under the notice of the members. It is the first instance, in France, of the conveyance of coke-oven gas to a distance.

The Coke-Ovens.

As stated above, the coke-ovens are situated at Roche-la-Molière, an important mining centre which lies at a distance of about 3¾ miles from Firminy. They are of the Koppers type, with horizontal chambers, 33 feet long, 20 inches average width, and about 8 feet high; and each oven has a capacity of 6 to 7 metric tons of coal. The setting consists of twenty ovens, and is 70 feet in length; and its capacity is from 120 to 140 metric tons of dry coal. Carbonization takes 28 hours when the charge of coal is only compressed by its own weight; when it is rammed, from 34 to 35 hours are required. In 24 hours, 100 metric tons of dry coal are carbonized; and the yield of coke is about 80 per cent. The production of gas per 24 hours may reach about 883,000 cubic feet. The yield in the laboratory, without reckoning carbon dioxide and sulphuretted hydrogen, is rather more than 9000 cubic feet per ton. The Société des Fours à Coke guaranteed that half the gas produced would be sufficient to heat the ovens, and that the other half could be utilized for lighting.

Drawing Off the Gas.

In coke-ovens, as in ordinary retorts, the quality of the gas varies during the period of carbonization. It is rich, and has a higher illuminating and heating power, during the first hours, and finally becomes much poorer. Consequently, it is of great im-

portance to collect it at a specified moment, according to requirements and to the uses for which it is intended. The plant is arranged in such a manner that the gas can be collected in two separate hydraulic mains—one for lighting gas, and the other for gas to heat the ovens. These two mains are side by side, and parallel to the axis of the setting.

The gas is drawn from each oven through a single vertical pipe fixed in the centre and ending between the hydraulic mains. The extremity of the pipe is T-shaped; the two branches terminating in a valve chamber, which opens or closes the entrance to each of the mains. During charging, the gas produced escapes into the atmosphere through an outlet made at the top of the T, and usually closed by a cast-iron lid. The inlet valves to the hydraulic mains are shut. As soon as charging is finished, the outlet is closed, and the valve for the lighting gas opened.

At present, the Firminy Gas Company do not utilize more than about 140,000 cubic feet of gas per 24 hours at the period of maximum output, during the short days in December. Thus drawing off the rich gas can be easily limited to the most favourable hours. Moreover, part of the lighting gas is used to heat the boilers of the Roche-la-Molière electricity works. The service is regulated as follows: Immediately after charging, the ovens are connected with the lighting gas hydraulic main, and remain so until the twelfth or thirteenth hour. The period of carbonization is about 24 hours, when the coal has been previously rammed. Nearly half the gas produced is, however, drawn off during the first twelve or thirteen hours.

Condensing and Purifying.

From the hydraulic mains, all the plant is in duplicate for purification and condensation. One set of apparatus is utilized for the heating gas, and the other for the lighting gas. Only the latter will be dealt with. The collecting-pipes are made of sheet iron, and are laid with a considerable downward gradient; their diameter being 6 inches. The collector runs first to a separator formed by a cylindrical body divided into two compartments by a partition which is only half the height of the cylinder, so as to form a baffle-plate. The condensation products in the hydraulic main or the collector flow away into a pit. The gas then passes into two condensers, through which there is a flow of water, systematically cooled. The gas enters the first condenser at a temperature of 70° to 75° C., and leaves it at 35° to 40° C. (95° to 104° Fahr.). The second condenser is exactly like the first, and the gas issues from it at a temperature of 20° to 25° C. (68° to 77° Fahr.), according to the temperature of the atmosphere. The condensation products—the tar and ammoniacal liquor—are discharged into a pit, whence they are pumped into a settling-tank.

Exhausters and Pelouze Apparatus.

On leaving the condensers, the gas is quite free from ammoniacal liquor, but is still somewhat charged with tar. It then passes through cast-iron pipes into the exhauster-house, in which are the exhausters and the Pelouze and Audouin condenser for the removal of the last traces of tar. There is a triple set of all the mechanical appliances—one of each kind for the lighting gas, a second for the heating gas, and a third as stand-by, which, by the aid of valves and bye-passes, can be set working either for lighting or heating gas.

The gas passes first through a Beale exhauster, which acts, as usual, to regulate the pressure of the ovens; and on leaving this, it passes to the Pelouze and Audouin condenser. In the same room are the centrifugal pumps for circulating the cooling water, and also the tar and liquor pumps. All this plant is driven by belts and gear, with an electric 35 H.P. motor; a second one of similar power being kept in reserve.

Sulphate of Ammonia Plant.

There is a triple set of apparatus in the sulphate-house as in the exhauster-house; two of the sets being for normal service, and the third to be kept in reserve. In this house are the sulphate vats and the distilling columns for the ammoniacal liquor. In the Koppers system, sulphate production is direct—the gas being bubbled through a sulphuric acid solution. In ordinary working, a 58° Baumé acid is employed. It is first run into a lead tank and thence flows to the lower part of the sulphate vats, in which the liquid at first contains about 20 per cent. of acid. This is partly neutralized by the ammonia in the gas, and consequently the acidity of the liquid may vary from 5 to 20 per cent. About 19 or 20 cwt. of sulphate are manufactured daily, for which 1540 lbs. of 58° acid are employed. The gas issues perfectly freed from ammonia.

The ammoniacal liquor distillation columns do not differ perceptibly from the usual apparatus. [The author described the apparatus in detail.] The method is somewhat roundabout; but it has, it seems, the advantage of making the production of sulphate more regular. The salt is also whiter, and of better appearance for sale. From 5500 to 6600 gallons of liquor are treated in 24 hours. The gas coming from the sulphate vats has a rather high temperature, which is reduced to 15° to 20° C. (59° to 68° Fahr.) in a small surface condenser. It must here be noted that there is a considerable quantity of naphthalene in the heating gas distilled at a rather high temperature. The lighting gas, on the contrary, distilled during the first hours of carbonization, and at a rather lower temperature, is almost free from it. The troubles caused by naphthalene in the mains of the Firminy Company, which were at one time very serious, have now disappeared as though by magic.

The foregoing are all the purifying operations carried on at Roche-la-Molière; the extraction of the sulphur from the gas being done at Firminy.

The Compressing Station.

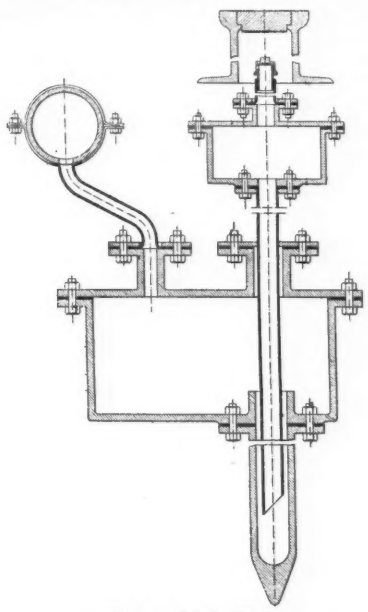
After leaving the last condenser, the heating gas passes to the coke-ovens to be burnt. The lighting gas has to be put under high pressure before being conveyed to its destination. It goes first into a small gasholder, of about 1000 cubic feet capacity, the object of which is merely to maintain a regular pressure of 6 inches, and afterwards into the compressing station, in which are located the station meters and the compressors. Provision is made for two outputs of gas, and there are consequently two meters—one of 212,000 cubic feet per 24 hours for Firminy, the other twice as large, to serve either as a stand-by or eventually to measure gas intended for the other towns.

There are three compressors (one being a relay), worked by belt and gear driven at each end by two 20 H.P. electric motors. A single motor is, however, equal to doing all the work—in fact, at the present time it runs with only one-third its normal load. The compressors are of the Roots type; and the one employed for Firminy will compress about 900 cubic feet of gas per hour to 60 inches of water. The compressors, like the centrifugal apparatus, have the merit of simplicity combined with efficiency. The electric motors are three-phase. They consequently run at a nearly constant rate. The speed of the compressors, however, must be varied according to the requirements of the gas-works. This is effected by two stepped cone pulleys, upon which the driving-belt is changed in position. At the head of the main there is an ordinary station governor, which completes the regulation of the pressure and the delivery of the gas at starting.

Conveyance of the Gas.

The length of the main from the coke-ovens to the gas-works is 4¼ miles. It consists of 6-inch cast-iron pipes with flexible rubber joints of the Berthet type. Joints on this system, which was devised by a plumber-contractor of Firminy, are highly appreciated in the locality, as they give great flexibility to a main, and enable it to sustain extension or contraction lengthwise or be bent transversely without detriment to the soundness of the joint. These are great advantages in a mining district, where there are necessarily subsidences of the soil.

The main starts at an altitude of about 1720 feet, and runs along a plateau intersected by small valleys to reach the culminating point at a height of 1880 feet. Farther on it descends into the valley of Firminy, and enters the gas-works at a height of 1528 feet —*i.e.*, nearly 200 feet lower than the starting-point.



Section of Drip-Well.

There are only a few elbow joints on the main. Seven drip-wells have been put in to collect the condensed water. Owing to the great pressure there may be in the main, these wells are of a special form. [One is shown in section in the accompanying diagram.] They have a small interior cavity, very deep, into which the discharge-pipe dips. The latter is thus surrounded by a water-seal 6 ft. 6 in. deep. Great attention was paid to the joints during the laying of the main. Each section, about 500 feet in length, was tested, before being covered with earth, with an air-pump at a pressure of 26 feet of water. When laid, the entire main was tested at the same pressure, so as to make sure that leakage would be a negligible quantity.

Some tests were made to ascertain the loss of pressure in a long main on which there was no branch. Taking into account the correction for difference of altitude, which is 16-10ths, it was found that the Monnier formula gave figures too low by 20 to 25 per cent.,

while the Arson formula gave others which were much too high, as compared with the results obtained.

This is shown by the following figures:

Delivery per Hour. Cubic Metres.	Loss of Pressure in Millimetres. Observed.	Monnier Formula.	Arson Formula.
64	220	187	344
80	80	51	133
150	50	33	87

The main cost £2800, or about £658 per mile, everything included.

Starting the Coke-Ovens.

The ovens were started towards the end of October last; and at Firminy they merely connected the pressure main with the exhauster main. For about a month the manufacture of gas in the old retorts was continued, as a matter of prudence; and the two plants worked simultaneously. Regulation was very simple, by manipulating the valve at the end of the high-pressure main. After a month's trial, the gas-works were closed, and the consumers supplied with coke-oven gas exclusively. It contains a good deal of sulphur, which is taken out by the old purifiers; but the operation is more costly than before, though the services of some of the men who are not employed in the daytime are utilized.

Practical Results—Quality of the Gas.

At the outset, during November last some trials were made to regulate the coke-ovens. It had to be ascertained by experiment what pressure was most suitable, as well as the best time for drawing off the lighting gas. When this was accomplished, and the regulation clearly specified, the gas was always highly satisfactory in quality. As to its composition, the heavy hydrocarbons figure to the extent of 3 to 4 per cent. It is rather rich in methane, and contains little carbon monoxide. This depends upon the quality of the coal carbonized. The illuminating power of the gas consumed with a batswing or bengel burner is somewhat less than formerly; but the principal requirement is gas of good calorific power. This varies from 520 to 550 calories per B.Th.U. gross, at 56° to 60° Fahr., and 30 inches of the barometer—corresponding to the local altitude. It is tested with the Junkers calorimeter. The gas is perfectly free from both tar and ammonia, and up to now also from naphthalene. It is quite suitable for incandescent burners, as it does not clog them. The Firminy Company buy the gas, and measure it at their station meter before it enters the holders.

In conclusion, the author would only add that coke-oven gas seems quite suitable for street lighting in large towns, and its use deserves more general attention whenever the vicinity of these ovens permits. It would, however, be prudent not to accept, in contracts, a high standard of illuminating power; but it may be stipulated, without fear, that the calorific power will be normal, and such as will give perfect satisfaction to the consumers.

DISCUSSION.

The President (M. Boutan) said the interest of the communication lay in the fact that it related to a quite recent installation. Coke-ovens and the gas coming from them were not direct competitors with the gas industry. They were an industrial necessity to which gas suppliers must submit; but the latter should complete the manufacture and ensure the distribution of the gas which the cokeries delivered to them. They must regard coke-oven proprietors as associates to whom they could render service, and who could reciprocate it.

M. Grebel remarked that in Germany the lighting gas was not drawn off till after the first hour of distillation, in order to avoid the entrainment of too much aqueous vapour. This manner of proceeding, which was different from that adopted at Roche-la-Molière, was explained by the almost exclusive use of washed coal in Germany. There also they regulated the production of lighting gas by simply varying the number of ovens from which it was being drawn.

M. Chéret pointed out that at Roche-la-Molière only eight ovens out of twenty were set apart for the separation of lighting gas, and that, if necessary, this number could be reduced. An automatic regulator could be employed to ensure the output, and divert for heating purposes the excess gas produced.

M. Grebel said that in Germany a good deal of attention was being given to the joints of pipes to be used for the conveyance of high-pressure gas. The diameters easily reached from 16 to 20 inches; and it was customary to employ either Mannesmann joints, which were tolerably flexible, or one of the twelve different kinds which had been devised for the house of Thyrsen. M. Gouvy had stated in a recent publication that half the gas produced by coke-ovens could be utilized for lighting, with a calorific power of 5000 calories per cubic metre (aqueous vapour not condensed), provided it was not washed with oil for the extraction of the benzol. M. Grebel confirmed this statement so far as the Rhine-Westphalian works were concerned. In no case was the benzol taken out; and managers were satisfied with physical and chemical purification at the start. In nearly all cases, the sulphur and the naphthalene were taken out at the works where the gas was made.

M. Busine stated that in Belgium they did not take off lighting gas until after the first hour, and that this gas had a calorific power which varied according to the kind of coal used and the exigencies of the market. But it could easily be kept at 5000 to 5200 calories per cubic metre. In certain contracts in which the calorific power was imposed by towns, the coke-oven people had to provide a sufficient quantity of benzol to bring up their gas to the desired calorific standard, in case of insufficiency. In considering the price at which coke-oven gas was offered, it must not be forgotten that benzolizing plant must be provided at the works receiving the gas, and that it was necessary to have an installation of (say) water-gas plant to guard against strikes at the coal mines. Additional storage might also be required. All these measures of safety, and the expenses they would entail in labour (as the staff would have to be retained in order to be ready for eventualities), must be taken into account in comparing the manufacturing cost and the selling price of gas. The question of the jointing of the mains was one of considerable importance in a coal-mining district, where it was by no means rare to see pipes drop to the extent of more than 3 feet in the course of a year. Under these conditions, cast-iron pipes with lead wool joints developed leaks; and in some recent work in which Mannesmann tubes from 26 to 32 feet long were employed, a double joint was made—one with india-rubber of the Somzée kind and the other with lead wool.

COMPOSITION OF TAR OILS.

By M. Ch. Ab-der-Halden.

[Abstract of a Paper read before the Société Technique.]

In the absence of definite knowledge of the proximate constituents of coal, examination of tar has been based on the general properties of its many components. These methods have included: (1) Saturation with acid, removing the ammoniacal and amine bases; (2) saturation with alkali, removing the acid-like bodies, such as phenols; and (3) fractional distillation, separating the neutral bodies. By such means as these, the many substances in tars have been isolated. Dr. Lunge, in his treatise on "Tar Oils and Ammoniacal Liquors." mentions some eighty different compounds as existing in tar. Most of these are obtained by fractional distillation; but the method is open to the serious objection that, at the temperatures to which it is necessary to go in order to distil off the anthracene oils, many secondary reactions take place, and other bodies are formed by decomposition and polymerization—changes that are evidenced by the production of aqueous vapour near 350° C. Thus the residue from the distillation is not free carbon, but a complex mixture, containing, in addition to carbon, heavy oils, and forming the familiar pitch.

The experiments described below were made with the object of isolating the oils boiling at high temperatures without employing fractional distillation, of studying their properties, and of discovering their influence on tars in general. A chance observation very greatly contributed to the experimental work. It was noticed that on mixing tar in the cold state with its own weight of petroleum ether (boiling-point 60° to 100° C.), it separates into two parts—one a viscous pitch almost solid, and the other a supernatant fluid. Analysis has shown that the former includes the whole of the pitch, while the latter contains the ordinary tar oils in admixture with the petroleum ether. Thus, in the case of a tar from French coal, the results were as follows:

	In Oils.* Per Cent.	In Viscous Pitch.† Per Cent.
Light oils (0° to 15° C.)	15	—
Medium oils (150° to 300° C.)	42	11
Heavy oils (300° to 370° C.)	23	7
Pitch, dry (above 370° C.)	15	76

* 42 per cent. of tar. † 58 per cent. of tar.

These results show that the method permits of separating the tar oils boiling above 370° C.; and, as it does not subject them to decomposition by heat, it yields them in the actual state in which they exist in the tar. Thus pitch may be regarded as consisting, in large proportion, of a substance insoluble in petroleum ether and of the free carbon of the tar. This property of petroleum ether permits of obtaining at a low temperature the principal constituent of pitch, which may therefore be called "pitch oils."

These oils may be extracted from tar or from pitch. In either case, the method consists in first removing the tar oils with petroleum ether, and then extracting the pitch oils with a suitable solvent—*e.g.*, toluene or carbon bisulphide. The two following procedures have been found to be the best:

(1) *Extraction from Tar.*—The tar is mixed with five times its weight of toluene, and heated for two hours on a sand bath under an inverted condenser. The free carbon is filtered off, and the residue washed with boiling toluene until the latter runs off colourless. Extract and washings are mixed. They contain both the tar and pitch oils, and an equal bulk of petroleum ether is added. The mixture is shaken and left for a quarter-of-an-hour. The pitch oils are insoluble in the mixture of toluene and petroleum ether and precipitate as dark flakes. They are collected in a filter, washed with petroleum ether, and dried *in vacuo*. By this means the oil obtained amounts to from 5 to 10 per cent. of the tar treated.

(2) *Extraction from Pitch.*—Dry pitch is finely powdered and extracted with petroleum ether in a Soxhlet tube until the liquid passes through colourless. This treatment removes the heavy oils remaining in the pitch. The petroleum ether is then replaced by carbon bisulphide or toluene, and extraction continued as

before until the liquid runs through colourless. The solution of pitch oils is cooled and filtered, and hence its bulk of petroleum ether is then added to the solution. The pitch oils precipitate, and are collected as before. In this way, the proportion of oil obtained from pitch is from 20 to 30 per cent.

Prepared by one or other of these methods, the pitch oils have the appearance of a chocolate brown powder of light substance, and free from odour. When heated, they soften and become liquid between 190° and 195° C.; the first melting-point being sharply at 193°. On cooling, their appearance is very different; they form a bright black mass, of sharp fracture, dark red in colour when observed in a thin film, and extremely brittle. Both forms are soluble in tar oils, and more so in carbon bisulphide. They are insoluble in sulphuric ether, petroleum ether, and light petrols generally.

With the view of ascertaining whether pitch oils extracted from different tars are identical in composition—that is to say, constitute a definite product—analyses were made of oils from a French and an English tar. The results were:

	French Tar. Per Cent.		English Tar. Per Cent.
Carbon	94·340	..	94·290
Hydrogen	4·001	..	4·125

The figures are so close as to permit of the assumption of identity of the two products. Moreover, the melting-point was the same in each case—193° C. The mean of the two analyses is: Carbon, 94·32 per cent.; hydrogen, 4·06 per cent.—equivalent to an empirical formula $C_{79}\ H_{40}$, or practically $C_n\ H_{\frac{n}{2}}$.

Under reduced pressure (25 mm. of mercury), the pitch oils boil without decomposition at about 350° C.; and at atmospheric pressure, at 400° C. At the latter temperature, boiling is accompanied by a rapid decomposition, which gives rise to evolution of gas. The oils first become a viscous mass, and as the temperature is raised they leave a solid residue which consists for the most part of free carbon. The gas thus produced amounts to 150 c.c. per gramme of oil distilled, and has the following composition:

	Per Cent.
Carbon dioxide	Not determined.
Oxygen	*nil*
Heavy hydrocarbons	2·3
Carbon monoxide	*nil*
Hydrogen	50·2
Methane	47·5
Nitrogen	*nil*

As is well known, coal tars contain a certain proportion—from 15 to 30 per cent.—of free carbon, which can be precipitated by diluting the tar with a light oil. The carbon thus precipitated can be filtered off, and it exhibits all the properties of lampblack. On the other hand, if the raw tar be filtered, only a very small residue of carbon is obtained. Nearly the whole of it passes into the filtrate. It would thus appear that the greater part of the carbon forms, with one of the constituents of the tar, a mixture exhibiting most of the properties of solutions, and masking its ordinary physical properties.

It is evident that this constituent is not a tar oil boiling at a high temperature, for even anthracene does not form a homogeneous mixture with carbon. We have therefore assumed that the pitch oils possess this property; and the assumption is confirmed by an experiment as follows: The carbon was extracted from tar and calcined to remove every trace of organic substance. It was then mixed with its own weight of pitch oil, rendered fluid at a temperature of 200° C. The mixture was completely fluid, and, on cooling, presented the appearance of a perfectly homogeneous and highly compact pitch. This result was taken at first as indicating that the pitch oils possess the remarkable property of dissolving carbon; but, as will be seen later, this is not the case.

With the view of ascertaining the true condition of the carbon in tars, microscopic tests were made of mixtures of it with definite proportions of pitch oils. In order to obtain a standard for comparison, pure carbon, directly precipitated from tar, was first examined. This carbon was finely ground, and was suspended in benzene. A drop of the liquid was left to evaporate, leaving an impalpable deposit of carbon. A photo-micrograph showed that the carbon exists as coarse masses in which, even at high magnifications, it is not possible to observe elementary grains. Some of the same carbon was then mixed with pitch oils—viz., 5 per cent. carbon and 95 per cent. pitch oils. The mixture was rendered completely fluid, spread hot on a glass slip, and a film, thin enough to photograph in the microscope, was obtained by cooling. In the photo-micrograph at 300 diameters it could be seen that the carbon exists as single separate grains. A second test was made with 50 per cent. of carbon and 50 per cent. of oils. In this, despite the larger proportion of carbon, the grains were not merged into masses, but were distributed almost in a regular formation throughout the preparation. From these different results it may be said that the free carbon in tars is in the state of emulsion; the emulsifying body being the pitch oils. Similar preparations, made with tar oils boiling between 360° and 400° C. failed to show the same phenomenon until addition was made of pitch oils.

These tests serve to explain the facts noted in the early part of this paper. On treating tar with petroleum ether, the pitch oils, which are insoluble in this substance, are precipitated, and carry down with them the carbon, with also a little of the other oils. The mixture forms viscous pitch of the composition stated.

From the practical standpoint, it is probable that the pitch oils play an important part in the production of tar, and particularly in its "hydration." As is well known, tars condense at the same time as the ammoniacal liquors, and invariably retain some of this liquor. Part—often almost all—separates in the tank by simple decantation; the remainder subsists distributed in some way in the tar, and can be separated only by heating above 100° C. We have tested a sample of tar containing 37 per cent. of water. A thorough examination showed that its percentage of pitch oils was almost *nil*, while it contained 30 per cent. of free carbon. It is easy to understand the effect of water. The free carbon, not being emulsified, does not form a practically compact mass, but exists in the form of more or less considerable aggregations, between which the drops of water are sheltered from physical treatment, even that of centrifugal separation.

This seems to be an adequate explanation for the following reason: If hydrated tar be brought to the boil, a thermometer will show that no water is driven off at 100° C., but only at some degrees above this temperature. The water, imprisoned among the aggregations of carbon, acquires a greater vapour tension at atmospheric pressure; and the removal of the vapour is sometimes accompanied by positive explosions. Moreover, we have prepared an artificial tar free from water and pitch oils, but containing 25 per cent. of carbon. On simple contact with ammoniacal liquor at the ordinary temperature, this tar absorbed 30 per cent. of water.

A further practical outcome of the properties of the pitch oils concerns the frequent blocking of pumps. It has been shown that these oils decompose at 400° C., leaving as residue a mass of compact carbon. It is almost certain that the same decomposition takes place in an overheated pump, and is the cause of the obstruction. Such conclusion is confirmed by the general opinion as regards the overheating of pumps—viz., that it is a rule of prudence not to exceed 350° C.

As regards the effect of different coals on the production of pitch oils, and that also of different modes of distillation, experiments were made in one of the works of the Continental Union Gas Company, and were carried out on three varieties of coal—two French and one German from the Sarre. Each coal was carbonized under identical conditions (eight charges of six hours), and the tar collected by special means by which each production was kept separate. The results were as follows:

Coal.	Pitch Oils in Tar. Per Cent.		Free Carbon in Tar. Per Cent.
French	6·75	..	25·35
"	8·40	..	25·96
Sarre	9·25	..	24·54

Thus the quantity of pitch oils varies to a material extent, while the proportion of carbon is very nearly the same in each case. The explanation no doubt is that, the carbon being a product of decomposition by heat, its quantity depends chiefly on temperature, and on conditions of decomposition—*e.g.*, the construction of the furnace. On the other hand, the pitch oils would appear to be a definite decomposition product of coal; and their proportion in the tar would vary with the nature of the coal distilled.

At the close of the paper, the President (M. Boutan) thanked the author for his original work, which, he said, constituted a very important contribution to the study of tars, and furnished a simple explanation of their very variable hydration. M. Guillet asked the author why he gave to a solid body the name of "oil"—an appellation which, at first sight, was a little disconcerting. The author replied that the reason was that, being easily fusible, it had, in the liquid state, an oily appearance. Answering another question, he said that there exists almost certainly a relation between the proportion of pitch in pitch oil and its agglomerating properties.

ARTIFICIAL LIGHTING OF IRON FOUNDRIES.

The following is the report by Mr. D. R. Wilson, to which reference is made in the notice, in another part of the "JOURNAL," of the last annual report of the Chief Inspector of Factories and Workshops.

In connection with the inquiry, forty iron foundries in different parts of the kingdom were visited in order to ascertain the efficiency of the artificial illumination.

So far as the actual carrying on of the work is concerned, the intensity of the illumination appears to be of little importance. At the moment of pouring, ample light is derived from the molten metal itself, and the previous and subsequent processes can be, and often are, carried out with the aid of supplementary light obtained from portable lamps. Insufficient light is undesirable from the point of view of accidents, caused by stumbling during the passage from one part of the foundry to another, especially when handling metal or when passing near moulding pits or parts of the foundry in which metal has been recently poured. In other words, "general" rather than "local" illumination seems to be the important matter to be considered.

General Characteristics.

From the point of view of lighting, an iron foundry possesses

Table A.—Well-Lighted Foundries.

Index No.	Class of Work.	Floor Space (Square Feet).	Means of Lighting.						Quality of Illumination.	General Description of Lighting Arrangements.	Illumination (Foot-Candles).		
			Kind.	Number.	Candle Power.	Height (Feet).	Distance Apart.				Maximum.	Minimum (Normal).	Minimum (Actual).
							Between Units in Same Row.	Between Rows.					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	Heavy. .	51,200	Flame arcs	32	3000	14	40	40	Excellent	Four bays with eight arcs in each, spaced opposite each other. Lighting uniform and very good	3·9	1·5	..
2	Tubes .	8,760	Flame arcs	3	4000	..	22	8½	Excellent	Three arcs (one movable on crane) in centre row	1·2	0·8	..
			Metal filament electric lamps	12	150	..	..	..	..	The side bays are lighted by groups of three 50-c.p. metallic filament glow lamps	1·7	0·92	..
3A	Heavy. .	9,600	Flame arcs	2	2000	22	50	20	Excellent	Two 2000-c.p. flame arcs in centre row; on either side a row of 1000-c.p. flame arcs. Sides lighted by 150-c.p. electric lamps	2·2	1 6	..
			,, ,,	8	1000	11	30	20	..				
			Metal filament electric lamps	8	150	13	30	20	..				
3B	Heavy. .	15,980	Flame arcs	4	2000	18	34	31½	Excellent	A row of 1000-c.p. arcs down centre. On one side a row of 2000-c.p. arcs; on the other a row of 80-c.p. electric lamps	2·2	1 6	..
			,, ,,	8	1000	18	34	31½	..				
			Metal filament electric lamps	11	80	9	14½	31½	..				
4	Medium .	10,260	Inverted arcs	11	?	12	45	19	Excellent	Inverted arc lamps are fixed to pillars by brackets which can be moved horizontally so as to serve any desired point within a semi-circle of 12 feet radius. The diffused light prevents the formation of shadows	6·5	0·4*	..
5	Light . .	3,840	Arc lamps (ordinary)	4	?	10-15	50	30	,,	Two rows of two arc lamps, spaced alternately. Illumination in main foundry good and uniform, but an adjacent extension is very badly lighted by a single flare lamp, pending the installation of arcs	5·0	1·7	0·09 to 0·024
6A	Heavy. .	11,700	Arc lamps (ordinary)	10	?	30	26	..	,,	A large foundry well lighted by a single row of lofty arcs down centre; at one end additional arcs are fixed to the wall. Illumination is very uniform, and the great height of the light sources tends to prevent shadows	2·2	1·8	..
6B	Pipes . .	3,080	Metallic filament glow lamps	7	150?	12½	17 to	25	Good	A smaller foundry well lighted by metallic filament lamps with reflectors, spaced at varying distances	1·8	0 88	0·46
7A	Light . .	2,850	Arc lamps (ordinary)	4	?	29	12	..	,,	Well and uniformly lighted by a single row of arc lamps placed down centre	0·53	0·50	..
7B	,, . .	2,800	,, ,,	3	?	17	23	..	,,	Well lighted (except in one corner) by a single row of arc lamps placed down centre	0 80	0·46	0·082
8	Heavy. .	126,600	Flame arcs	91	3780	17–22	43	64½	Excellent	A very large foundry lighted throughout by flame arc lamps in seven rows. The illumination is very uniform	2·8	1·80	..
9	Bedsteads	3,283	High-pressure gas (inverted)	8	200	9	9	17	Good	The main foundry is well lighted by two rows of high-pressure gas-lamps. A gallery extends along one side, and under this the illumination is poor	1·4	0·88	0·26
10	Light . .	1,440	Three-mantle incandescent gas (inverted)	2	1500?	8½	25	..	Fair	A small foundry lighted by two composite incandescent gas-lamps, each containing three mantles. Some of the mantles are in poor condition	1·8	0·35	..
11A	,, . .	21,600	Arcs (ordinary)	16	?	20	40	30	Good	Foundry divided into six bays, each containing three arc lamps (some in poor condition) spaced "alternately" in each bay	1·4	0·46	..
			Arcs (flame)	2	?	20	40	30	..	One bay containing two flame arcs is specially well lighted	2·0	1·60	..
11B	Heavy. .	4,500	Arcs (ordinary)	11	?	14	20	15	Very fair	Arc lamps are spaced along one side and half-way along the other, and one arc is fixed at each end. Lighting rather uneven in part where there is a single row of arcs	1·4	0·40	..
12	,, . .	7,000	Flame arcs	4	1800	26	40	35	Good	Arc lamps arranged symmetrically throughout. One Osram lamp fixed in corner for bench work. At the time of observation, there was much smoke, so that the results are abnormally low	1·4	0·23	..
			Metallic glow lamp	1	600	11	..	..					
13	,, . .	4,170	Arcs (ordinary)	6	?	10	15	..	Fair	The lamps (an old-fashioned type of arc) are arranged in a single row down the centre, the sixth lamp being in one corner. They are practically unshaded, and being placed very low (10 feet) they are liable to cause glare and to dazzle the eyes of persons moving about. Portable lamps are used by the moulders	3·6	0·26	..
14	Light . .	3,880	3-mantle incandescent gas (inverted)	4	1500	26	34	..	Very good	A long, narrow shop provided with a single row of 3-mantle inverted incandescent gas-lamps in good condition, and fixed high up	1·8	0 70	0·36

* This minimum is temporary only; it varies with the position of the movable light source.

Table A.—Well-Lighted Foundries—*Continued.*

Index No.	Class of Work.	Floor Space (Square Feet).	Means of Lighting.						Quality of Illumination.	General Description of Lighting Arrangements.	Illumination (Foot-Candles).		
			Kind.	Number.	Candle Power.	Height (Feet).	Distance Apart. Between Units in Same Row.	Distance Apart. Between Rows.			Maximum.	Minimum (Normal).	Minimum (Actual).
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
15A	Heavy. .	6,000	Arcs (ordinary)	4	600	25	30	..	Good	The foundry is lighted by a single row of ordinary arcs spaced down centre	5·0	0·66	..
15B	,, . .	7,000	Metallic filament glow lamps	8	150?	10	30	..	Fair	The lamps are spaced in a single row down centre. An annex to the above	3·2	0·40	..
15C	Light . .	3,150	,, ,,	4	150?	16	30	..	,,	The lamps are ranged in a single row in centre	2·2	0·38	..
16A	Heavy. .	9,400	Flame arcs Metallic filament glow lamps Gas-jets	3 2 3	1000 2500 ?	30 ? 5½	55	.. .. ..	Good	The main foundry is well lighted by a single row of flame arcs with metallic filament lamps in corners. An annex is less well lighted by gas-jets aided by light borrowed from main foundry. (Col. 14.)	5·9	0·58	0·28
16B	,, . .	4,000	Arcs (ordinary)	2 2 2	1000 500 250	12	20–30	.. .. ..	Excellent	The lamps are arranged irregularly in foundry	2·0	1·40	..
16C	Steel . .	5,600	Flame arcs	3	1000	28	60	..	,,	The lamps are arranged in a single row down centre	2·7	1·90	..

Table B.—Badly-Lighted Foundries.

17	Bedsteads	7,400	Upright incandescent	3	?	7½	30	..	Poor	Gas-jets placed irregularly throughout. The system is about to be changed, and experiments are being made with clusters of electric glow lamps under wide reflectors. The high vertical moulds tend to cause shadows	0·64	0·17	..
			Ordinary gas	10	?	5–6	Varies		..				
18A	Light . .	6,050	,, ,,	46	?	5	Varies		Bad	Lighted at one end by groups of four gas-jets 7 feet high and 12 to 17 feet apart. The other part lighted solely by movable gas-jets on benches	0·12	0·04	..
18B	,, . .	11,080	,, ,,	60	?	6	18½	10–17	Very poor	Lighted by five rows of double gas-brackets	0·62	0·10	..
19	,, . .	6,080	Ordinary gas (groups of 9 jets)	5	?	20	22	..	Poor	One part is lighted by a row of groups of nine gas-jets 20 feet from ground. The other part by double gas-brackets and jets on benches	1·0	0·20	..
			Single gas-jets	31	?	6½	11	12½	..		0·32	0·30	..
20	,, . .	3,630	Ordinary gas-jets	..	?	6¾	10	18½	Poor	A small foundry lighted by double gas-pendants arranged in two rows	0·65	0·16	..
21A	Hardware	1,480	,, ,,	9	?	4	Varies		Very bad	Small foundries very badly lighted by gas-jets placed irregularly on benches	0·74	0·038	..
21B	,, . .	635	,, ,,	4	?	3¾	Varies		,, ,,		0·40	0·030	..
21C	,, . .	2,240	,, ,,	11	?	4	8	Varies	,, ,,		0·20	0·048	..
21D	,, . .	1,910	,, ,,	18	?	4	6	Varies	,, ,,		0·24	0·094	..
21E	,, . .	500	,, ,,	3	?	4	Varies		,, ,,		0·46	0·042	..
22A	,, . .	2,430	,, ,,	10	?	4½	8	Varies	,, ,,	A small foundry badly lighted by gas-jets arranged along wall, and one group of gas-jets in centre	0·66	0·018	..
22B	,, . .	3,800	,, ,,	9	?	4½	Varies		,, ,,	A small foundry lighted by gas-jets irregularly arranged	0·35	0·016	..
23	Light . .	2,080	,, ,,	4	?	10	Varies		,, ,,	A small foundry lighted by gas-lamps of various types placed irregularly. The mantles of the incandescent lamps are in poor condition, and, being unshaded, are liable to cause "glare." Not lime-washed	0·28	0·040	..
			Incan. (upright)	2	?	10							
			,, (inverted)	2	?	10							
24	,, . .	1,500	Ordinary gas-jets	9	?	8	Varies		Moderate	An old ramshackle shop with large batswing burners placed irregularly. The illumination is not very low, but the lights flicker, and are generally unpleasant. Not lime-washed	0·64	0·220	..
24B	,, . .	1,060	,, ,,	6	?	4	13	24	Very poor	Rows of single gas-jets along each side of shop. One jet broken off. Not lime-washed	0·20	0·064	..
25A	Pipes . .	47,520	,, ,,	130	?	3½–6¼	10–18	About 30	Poor	A very large foundry poorly lighted with gas-jets placed irregularly. Only a small part of the shop was lighted at the time of visit	0·16	0·032	..
25B	,, . .	9,900	,, ,,	38	?	6	10–20	Varies	,,	A smaller foundry lighted by double gas-brackets irregularly arranged	0·24	0·058	0·05
26A	,, . .	24,700	,, ,,	95	?	5-6	15	,,	Bad	A large foundry lighted by rows of double gas-brackets placed irregularly	0·26	0·060	..
26B	Medium .	4,500	,, ,,	6	?	3½	22	50	Very bad	A small foundry lighted by a row of single gas-brackets on each side wall. The travelling crane is said to be a difficulty in the way of improving the illumination	0·07	0·020	..

several characteristics which are either absent or less pronounced in other works:—

1.—The whole of the floor space is covered with very dull and dark material. Measurements of the diffused reflecting power of this surface indicate that only about 2 to 3 per cent. of the incident light is reflected.*

2.—The material covering the floor is of uniform colour, and there is almost complete lack of contrast throughout the room. There is, therefore, no surface to serve as a contrasting background for obstacles, which are often difficult to distinguish.

3.—The processes involve the production of much dust, and at certain stages of the work dense smoke is evolved.

4.—Shadows are said to be specially undesirable, probably on account of the further reduction of the illumination.

5.—Glare is liable to result from the molten metal (and sometimes from badly shaded light sources placed too low), with the consequence that the eye is temporarily dazzled, and risk of stumbling is increased.

From the foregoing remarks, it will be seen that for efficient lighting the illumination in iron foundries should be high compared with other rooms. Objects of similar and very low diffused reflecting power are the more readily distinguishable the more intense the illumination received by them, since contrast is enhanced by the increased difference in the amounts of light reflected. More efficient contrast could also be obtained, especially in small foundries, by frequent limewashing of the walls, the white surface of which would then serve as a background for the dark-coloured objects on the floor. In addition to this advantage, a white wall does much to increase the actual illumination, especially with natural lighting. The walls in many foundries are lime-washed; but they are often almost black owing to deposit of dust.

The presence of smoke in any quantity greatly reduces the illumination on the floor, especially when the light sources are situated high up. This is, generally speaking, only a temporary matter, since the smoke soon makes its escape from the room. But it constitutes one more argument in favour of as intense an illumination as possible.

Dust, according to the report, has a more permanent deleterious effect in foundries where incandescent gas is the illuminant, since it is said to injure the mantles and block the air orifices. On the other hand, it was found that incandescent gas systems are frequently adopted, and, if suitable precautions are taken (such as protection of the mantles by glass shades, use of powerful units placed high, &c.), this method of lighting appears to give complete satisfaction, and is very efficacious as regards illumination. [See Table A, Nos. 10 and 14.] Dust also quickly destroys the whiteness of the walls by settling on them. This can be obviated, at any rate to some extent, by brushing-down at frequent intervals. The dazzling effect of the molten metal is, of course, unavoidable, and is more or less temporary. Glare from high intensity light sources has been noticed occasionally, owing to their being placed too low. [See Table A, No. 13.]

Shadow is said to be specially undesirable, as tending to confuse the eye and as reducing the illumination. In considering shadow, three points are of importance—viz., position, extent, and depth. The position of a shadow is determined by the position of the responsible light source. The latter should, of course, be placed in the locality in which the shadow is undesirable. The extent of the shadow depends on the height of the light source; the greater the height, the shorter the shadow. The depth depends on the presence or absence of neighbouring light sources, or, in other words, on the evenness or unevenness of the illumination. For this reason, for the lighting of a given area, it is preferable to have two sources of (say) 1000-candle power each than a single source of 2000-candle power.

It would appear that the most satisfactory method of lighting is by means of powerful units, fixed as high as possible above the floor, and spaced comparatively close together. The tables on pp. 48 and 49 show that this method is adopted in most of the foundries classified as well lighted.

Results of Observations.

In estimating the efficiency of the lighting, the method adopted has been to ascertain the maximum and minimum illumination in each foundry; and these will be found tabulated in the appended tables. The maximum illumination is generally found directly or nearly directly under a light source, and is of little significance in computing the efficiency of the lighting as a whole. The minimum illumination is of two kinds, which are separately specified in the tables. "Normal" minimum [column 13] refers to the minimum which the given system of lighting affords—*e.g.*, for a single row of light sources some distance apart, it would refer to a point midway between two sources, &c. It often happens, however, that a foundry contains a specially dark corner or annex, for which the system of lighting is not to blame, but only the extent of the system. This minimum is included in the tables as the "actual" minimum, and in relation to the system of lighting must be regarded as abnormal. No account has been taken of any part of a foundry used for storage only or to which only occasional access is necessary.

All the observations have reference to a horizontal plane 1 foot above the floor level, and were made by means of a Holophane lumeter with a range of 0·01 to 1000 foot-candles.

The results of observation show that a sharp distinction may be drawn between well and badly lighted foundries. In some of the former, the very high minimum value of 1·5 foot-candles is attained and even exceeded; and the lighting may be considered good if the illumination does not fall below 0·5 foot-candle.

In the badly lighted foundries, it will be noticed that in almost all instances the system of lighting consists of ordinary flat-flame gas-burners. In addition to their feeble intensity, these have other disadvantages. They are of necessity placed low down, and in contrast with their dark surroundings tend to dazzle the eye. They are also liable to flicker unpleasantly, and to cause confusing shadows, and are uneconomical from the point of view of gas consumption. Only one foundry lighted in this way could be described as even moderately well lighted [see Table B, No. 24]. The others vary from poor to very bad. The actual data indicate the extremely bad lighting that exists in some of these foundries; measurements as low as 1-60th of a foot-candle being recorded. [See Table B, No. 22B.]. Some idea of this deficiency may be given when it is remembered that the minimum illumination in a poorly lighted suburban street is about 1-100th of a foot-candle. It is probably impossible to secure really efficient lighting with old-fashioned gas-jets; and these should be replaced by some modern high intensity system under expert advice, whereby not only would the illumination be greatly increased, but a large saving in the amount of gas consumed would follow.

The investigation appears to show that the illumination received on a horizontal plane one foot above the floor-level in well-lighted iron foundries does not fall below 0·5 foot-candle; fairly lighted do., 0·3 to 0·4 do.; moderately lighted do., 0·2 to 0·3 do.; poorly lighted do., 0·1 to 0·2 do.; badly lighted do. is below 0·1 do.

It would seem, therefore, that the lighting cannot be deemed to be adequate unless the illumination received on a horizontal plane 1 foot above the floor-level is not less than one-third of a foot-candle over any part in which work is being carried on, or over which any person is liable to pass.

* This refers to iron foundries only. In steel foundries a light-coloured sand is used, and the diffused reflecting power is about 10 per cent.

INTERNATIONAL ROAD CONGRESS.

Last Week's Meeting in London.

At the Third International Road Congress, which was held at various centres in London last week, a large number of reports were submitted on matters of special interest to highway authorities. The subjects dealt with included methods of lighting public highways and vehicles and the making of roads. The reports did not contain a great deal of particular interest to "Journal" readers; but a few notes from them may be given.

METHODS OF LIGHTING HIGHWAYS.

There were in all seven communications in connection with "Methods of Lighting Public Highways and Vehicles." The first was by Herr G. Fleck, of Dresden, who states that, in order to ascertain what amount of importance is to be attributed to the lighting of public streets from the point of view of traffic regulation, a list of queries was sent to 93 German towns; and it was found that by far the greatest number still employ coal gas or water gas. Compared with gas, the electric light is still holding a somewhat subordinate position; and it is only in a few towns—especially in the smaller ones—that electricity has so far gained the upper hand. There are towns in which either there are no gas-works at all, or in which the gas-works are in the hands of companies. Expressed in figures, the ratio is that electricity prevails in four towns, and gas in the other 89 places. For illuminating roads in parks, electricity is, for various reasons, more extensively used. The report says: "It is an interesting fact that Berlin, the capital of the Empire, is supplied with electric current exclusively by companies, whereas the greatest number of the gas-works are owned by the town. This explains why gas-light is preferred, and why such strenuous efforts are being made in Berlin to make gas-light as effective as the electric light, both as regards intensity and appearance." Considering the towns generally, the upright Welsbach mantle holds by far the largest field. The amount of light provided in the towns is, generally speaking, sufficient to make traffic after dark possible without danger.

Herr Leo Stransky, of Vienna, expresses the opinion that the lighting of public roads in places of an urban character is, with a few exceptions, insufficient; and the traffic is only safe in the main thoroughfares of large towns where either electricity or compressed gas is used for lighting. He maintains that the lamps should be suspended from two-armed masts in the centre of the road, not at too great a height from the road, so that the illuminating effect, which apart from the power of the source of light is directly proportionate to the sine of the angle formed by the incident rays of light with the horizontal, should be as large as possible. Where, owing to the insufficient width of the road, masts cannot be erected in the centre, it is advisable to suspend the lamps from wire ropes stretched across the road. Only in places where neither of these alternatives can be adopted should the lamps be suspended from masts erected along the buildings; but in this case they should be carried on arms projecting into the roadway. The intensity of illumination should be such that

an element of surface in the roadway situated half-way between two lamps should be illuminated at the rate of at least 25 *lux*.

It is admitted by M. Hansez, of Brussels, that the lighting of public thoroughfares in towns has greatly improved of recent years; but he says he thinks this is due to the wider application of electric light, which, in Belgium at all events, extends even to the smallest villages, though the greater portion of the streets in large cities are still lighted by gas. From the point of view of illumination of the public thoroughfare, globes of transparent glass are less effective than those of ground or opaque glass, because the light is not so well diffused. The roads in open country should not be illuminated; it is the vehicles which should carry lights. There are, however, certain points, such as level-crossings, bridges, &c.—along the route outside towns which must be lighted. Many accidents, also, happen from inadequate lighting of roads under repair, or in which pipes are being laid; and one might stipulate for more effective control of this matter by the authorities.

In a report outlining modern American practice in street lighting, Dr. Clayton H. Sharp, of New York City, says that the lighting there of highways by gas, though enormous in extent, presents few novel features of sufficient importance to be noted. High-pressure lighting, which is used with such brilliant effects in Great Britain and on the Continent, has not as yet been introduced into America on a practical scale. The great bulk at least of the gas lighting is done with single-mantle upright burners, though in as important a city as Philadelphia open flames are still used. It must, however, be said that the gas furnished to these flames is of much higher candle power than is usual in European cities. In a brief consideration of the principles of street illumination, the author says that, in order to bring the visibility of objects to the highest point, it is necessary to make the street surface as bright as possible—that is, to direct the maximum amount of luminous flux towards the surface of the street. The light which falls in horizontal rays on moving objects is more likely to be detrimental to good seeing than otherwise. Therefore the proportion of vertical rays in street illumination should be as high as, from practical considerations, it can be made. The character of the street surface is of the greatest importance in determining the visibility of objects thereon. An application of oil or tar to roads without the use of a light-coloured top dressing is, from the illumination point of view, extremely bad practice. Reference is made to curves showing the brightness of asphalt when viewed from different directions, by which it is seen that the brightness is far greater in line with the lamp, due to regular reflection from the asphalte surface. This, he says, emphasizes the importance of hanging the lamps either over the centre of the street or well over the pavement, if the illumination is to be most effective in giving the surface of the street an appearance of brightness. Dealing with the question from the aspect of glare, the view is expressed that horizontal rays of light from street-lamps are objectionable, and that a suppression of such rays would in many cases be advantageous. Where the lamps are close together, this is quite feasible to carry out. A diffusing globe will largely mitigate glare; and the lamps should also be raised well above the field of vision. As to illumination values required, he remarks that Dr. Bell assigns for important business streets an illumination of not less than 0·5 *lux* at the minimum and fully 1 *lux* as an average value for the illumination on the street surface; for quiet residential streets, a minimum value of 0·25 *lux* and an average of not less than 0·5 *lux;* and to streets with very little traffic or few buildings, a minimum of 0·1 *lux*. It is pointed out that these are moderate figures, but that, if we regard only the illumination of the surface, they would give a well-lighted street. Under the heading of the arrangement of lamps, it is admitted that the most desirable place, for the purpose of illuminating the entire street, is over the centre of the road, though this method has its disadvantages. Subsequently, it is stated that, in the case of gas-lamps, the reflector does not seem to have received the careful attention which should be accorded it. Considering the choice of plane of measurement of light, the author says it appears that horizontal illumination is the only possible universal criterion for the quality of the street lighting.

M. Tur, of Paris, is of opinion that the existing state of affairs invites criticism, and that the facilities which electricity offers will allow of a continual increase in the number of lighted roads in the open country. Speaking of Paris, he says the lighting of the public streets is mostly carried out with gas. Electricity is only employed on some of the main arteries. At the close of the year 1911, there were in the Paris streets 2082 burners consuming from 20 to 200 cubic litres of gas per hour, 51,627 incandescent burners consuming from 40 to 1000 cubic litres per hour, and 362 high-pressure burners consuming from 1200 to 2400 cubic litres per hour.

The next report was by Mr. John S. Brodie, Borough Engineer of Blackpool, who says that a perusal of the annual returns of the gas undertakings in the United Kingdom discloses the fact that, in the smaller towns and villages, the flat-flame burner is still largely in evidence, with all its wastefulness and inefficiency. No uniform standard of illumination for street lighting applicable to all towns, or even to all parts of the same town, can, of course, be laid down. The chief objects to be secured in good street lighting are: (*a*) Good and—so far as is practicable—uniform lighting of the carriage-way and side footways; (*b*) absence of glare on the eyes, either casual or excessive; (*c*) uniformity of colour of the light itself. The author gives in his report an interesting summary of the most important improvements of late years in street illumination by means of gas, and the different lighting and extinguishing devices.

Finally, there was a short report by Mr. H. Merczyng, of St. Petersburg, who, however, dealt only with the matter of public lighting by electricity.

There was some discussion of the reports; and, among others, the following resolutions moved by Colonel Holden (of the Royal Automobile Club) were carried without opposition: (1) For the purpose of general determination of methods of lighting, highways may be conveniently divided into three classes, as follows: (*a*) Important streets in cities, towns, or other urban areas in which traffic after dark is considerable in volume, (*b*) important suburban roads in the vicinity of large towns, (*c*) rural roads; and having regard to modern conditions of traffic, it is essential that adequate lighting by means of fixed lights should be provided in classes (*a*) and (*b*). (2) As a general principle in the lighting of all highways which require to be lighted by means of fixed lights, the method of lighting to be adopted should be such as will provide an illumination as uniform and free from glare as possible. The amount of illumination and the position of the lamps must be determined with reference to local circumstances.

ROAD CONSTRUCTION AND MAINTENANCE.

There were about a dozen reports on the construction of macadamized roads bound with tarry, bituminous, or asphaltic materials. One of them was an interim report on trials of road materials at Sidcup and in Wandsworth and Fulham; but as it is stated that no final opinions can be formed until the various sections coated require renewal or re-coating, it is unnecessary to deal with this now.

Referring to Germany, Herr Vilbig says that, as regards surface tarring, opinions about the value of this process applied to county roads are not unanimous. When crude tar is used, the durability of the tarring chiefly depends on the percentages of water and light oils in the tar. The higher the percentages are, the less is the tar suitable for road work. Tar is obtained in Germany from gas-works and coke-ovens. The two kinds are almost identical in composition; but the tar from coke-ovens is somewhat more suitable for roads, as it contains less water and soot than gas-tar. A clear knowledge as to the composition of the tar is necessary; and it ought to be insisted upon that the crude tar should no longer be allowed to be boiled on the site to free it from the ingredients which make it unsuitable for roads, but should be supplied by the distilleries ready for use, and of suitable quality. The most suitable mixture for surface tarring has been found to be from 50 to 55 per cent. of pitch to from 50 to 45 per cent. of heavy oils. The pitch should not become soft at a temperature of less than 65° C.; while the oil should be freed from all the more volatile parts, so that when heated to 210° C. the distillate should not exceed 1 per cent. The tar should be exclusively coal tar, and is not to contain more than 10 per cent. of its volume of tar or its bye-products obtained from carburetted water-gas manufacture. It should be perfectly free from water and ammoniacal liquor. The specific weight of the tar should be not less than 1·18 or more than 1·24 at 15° C. The amount of free carbon should not exceed 16 per cent. of the weight of the tar. When heating the tar to a temperature of 170° C., the distillate should not exceed 1 per cent. Tar without naphthalene crystals is to be preferred for surface tarring. The tar thus supplied should be heated at the roadside to 150° to 200° C., according to the season.

Herr Theodor Bradaczek (Vienna) is inclined to attach special importance to the exact time when the sand is put on the tarred surface; and, in addition to this, he thinks many surface tarrings have failed because the tarred area was too small, and was soon made dirty by the dust and mud brought thereon by traffic from the adjoining untarred road lengths. The report by Mr. D. E. Lloyd-Davies (Chief Engineer of the City of Alexandria) contained extracts which the reporter claims prove very conclusively that the damage to vegetation and plant life in general by dust from tarred roads has been considerably exaggerated. The extracts in question were taken from a report by Mr. Alfred Lucas (Expert Chemist to the Egyptian Government), dealing with the dust from a local tar-painted macadam road. The extensive use of tar spraying in France is indicated in a joint report from that country; and the remark is made that tar spraying is good, but to maintain it is no less important, and should figure among the first items of the programme for the work of a road engineer.

There was a report by a Committee (of which Mr. W. J. A. Butterfield was a member), which contained the following remarks on the effect of road tarring on public health, fish-life, and vegetation: "There is unanimous agreement that the benefit to health accruing from the construction of tarred or bituminously bound road surfaces is substantial; and this opinion is confirmed by the numerous satisfactory reports issued by medical officers of health and others. No reports of actual instances of injury to fish or vegetation have been obtained; and it is believed that when refined tar is used, no injury is caused to fish or vegetable life. An instance is given of surface tarring with crude tar having been carried on for eight years without complaint." From Switzerland, it is reported that surface tarring has been applied with good results in various avenue roads, without the trees having suffered from the process.

CREATING AN OUTDOOR STAFF.

Education Work at Waterford.

In connection with the paper read by Mr. F. W. Goodenough at the recent meeting of the Institution of Gas Engineers, on "Creating an Outdoor Staff," it will be recalled that Mr. J. G. Tooms referred to a four years' course of instruction provided by the Waterford Technical Institute for gas apprentices, particulars of which had been supplied to him by the Principal, Mr. B. O'Shaughnessy, A.R.C.Sc. (Lond.), F.I.C. The particulars, which have since been forwarded to the "JOURNAL" office, are given below. Before reproducing them, however, it will be well to give a letter from Mr. Tooms to the Principal, expressing his opinion on the question of day classes for apprentices. Mr. Tooms wrote as follows:

DAY CLASSES FOR APPRENTICES.

In a general way, I consider that one or two years' previous attendance at the Day Trades Preparatory Classes are of inestimable advantage to all boys, and, besides laying a sound foundation for future instruction, foster an interest in the principles of work and, I might almost say, the scientific side of the operations they are called upon to perform.

My view is that apprentices, as such, should attend technical classes during their apprenticeship; and if the guardians of a boy do not know what is for his good, or have not the control over him to make him attend the classes, there is no such excuse for the employer. Our boys who are recruited from the Day Trades Class are required to attend the technical classes during their apprenticeship, including the Day Apprentice Classes, during working hours; and evening students are not required to be at work until after breakfast following an attendance at school.

It is my decided opinion that attendance of our apprentices at these classes has materially added to their value to us; and they all promise to become most expert and highly-trained craftsmen.

From any apprentice's point of view, the fact that the employers allow his attendance at classes during working hours, &c., must demonstrate conclusively to him that his employer takes an interest in his attainments, and is satisfied as to the advantages, which of itself is of great value; and my experience is that the boys and young men respond to these concessions, and apply themselves to the work of these classes with the zest that all employees should bring to their work.

I am quite sure that we, as employers, are more than compensated for the loss of time, and interference with our routine, through allowing these apprentices off, by the increased efficiency and alert intelligence which characterize the apprentices who have attended these classes; a three years' apprentice being usually as useful, if not more so, than one who has served four or five years without attendance at these classes.

The improved position of the youth himself, and the possibilities open to him, call for no comment.

OUTLINE OF SPECIAL COURSE FOR GAS APPRENTICES.

First Year.—Mechanical engineering. Practical mathematics and geometry. Workshop practice. Freehand sketching of machine details.

Second Year.—Practical mathematics and mechanics. Mechanical engineering. Building construction. Elementary chemistry.

Third Year.—Practical mathematics. Mechanical engineering. Chemistry of gas manufacture.

Fourth Year.—Practical mathematics. Mechanical engineering. Gas engineering and supply.

SYLLABUSES OF THE SPECIAL DAY CLASSES FOR GAS APPRENTICES.

First Year.

SUBJECTS.—Workshop mathematics, mechanical drawing, and metal work.

WORKSHOP MATHEMATICS.

British and metric units of length; area; volume; mass, measuring instruments used in workshop.

Arithmetic.—Ratio; proportion; percentages; powers and roots; decimals; addition, subtraction, multiplication, and division.

Algebra.—Evaluation, addition, subtraction, multiplication, division; use of brackets; simple factors; fractions; simple equations and simple problems involving same.

Graphs.—Use of squared paper; co-ordinates; examples of simple graphs.

Mensuration.—Areas of following figures: Rectangle, parallelogram, triangle, and circle.

Boys who have completed the second year course in the Day Trades Preparatory School are given more advanced instruction, following on from that given in the Day Trades Preparatory School.

MECHANICAL DRAWING AND MACHINE DRAWING.

Scales and scale drawing; principles of projection and their application; care and use of drawing instruments; reading and setting out drawings; inking in and finishing; tracing; dimensioned freehand sketches of machine parts and accurate drawing to scale of same.

The machine parts dealt with will include: Belts; nuts; foundation bolts; locknuts; rivets and riveted joints; pipes and pipe-joints; shafting; keys and couplings; simple bearings; cranks; knuckle-joints; pistons; belt pulleys; speed cones; cylinder covers; stuffing-boxes, &c.

METAL WORK.

Exercises are graded to follow on from the metal work done in the Day Trades Preparatory School. Further instruction in: Properties of metals; correct use of hammer, chisel, and file; simple forge exercises; drilling, hand and power; sheet metalwork; soldering; use of stocks, dies, and taps.

Second Year.

SUBJECTS.—Mechanics, geometry, and metal work.

MECHANICS AND GEOMETRY.

Force, work, and power; simple problems on same; friction; inclined plane; screws, with experimental work and simple examples; efficiency of machines; mechanical advantage; parallelogram and triangle of forces; moments; levers; wheel and axle, with experimental work and simple examples; velocity, uniform and variable; acceleration; simple examples on uniformly accelerated motion of falling bodies; plan and elevation of cylinders, cones, prisms, and pyramids, using practical examples in sheet metal work; sections; development of surfaces.

METAL WORK.

More advanced exercises in the subjects of the first year syllabus, together with the use of the shaping machine, lathe, and brazing forge. As far as possible the operations are combined and embodied in tools that will afterwards be useful to the students in their work.

The following is a list of tools made by students: Centre punch; flat and cross cut chisels; callipers; square; smith's tongs; pipe-grips; clips; screwdriver; nut-gauge; scribing block; small brass and copper trays; box square; depth gauge.

EVENING CLASSES FOR GAS APPRENTICES.

First Year.

NOTE.—Department's programme means the programme of Technical School Examinations of the Department of Agriculture and Technical Instruction for Ireland.

I.—*Mechanical Engineering.*—Department's programme, p. 34.

II.—*Practical Mathematics and Practical Geometry.*—Department's programme, pp. 15 and 16.

III.—*Workshop Practice.*—See appended syllabus.

Second Year.

I.—*Practical Mathematics, Geometry, and Mechanics.*—Department's programme, pp. 17, 36, and 37, with also: Weight of various materials of construction; vectors; triangle, parallelogram, and polygon of forces; simple calculations to determine the sizes of beams; moment of inertia; riveted joints; roof trusses of the simpler type and stress diagrams; plate and rolled girders; foundation and safe pressures on foundations of masonry structures; the properties and strength of stone, brick, cement, mortar, concrete, cast iron, wrought iron, and steel.

II.—*Mechanical Engineering.*—Department's programme, pp. 35 and 36.

III.—*Building Construction.*—Department's programme, p. 15.

IV.—*Workshop Practice.*—See appended syllabus.

V.—*Elementary Chemistry.*—Department's programme, pp. 21 and 22.

Third Year.

I.—*Practical Mathematics.*—Board of Education (Lower).

II.—*Mechanical Engineering.*—Department's programme, p. 37, third year, Course B. & A.

III.—*Workshop Practice*—See appended syllabus.

IV.—*Chemistry of Gas Manufacture*—Introduction to study of organic chemistry. The following will be dealt with: Paragraphs 9, 10, 11, and 13, City and Guilds syllabus "Gas Engineering," Grade I., and paragraphs 1, 2, 3, 4, 5, 6, and 13, C. & G. Final.

Fourth Year.

I.—*Practical Mathematics.*—Board of Education (Higher), Part I.

II.—*Mechanical Engineering.*—Department's programme, p. 39, Courses A. & B., fourth year.

III.—*Workshop Practice.*—See attached syllabus.

IV.—*Gas Engineering and Supply.*—City and Guilds "Gas Engineering," Final Grade; "Gas Supply," Grade I.

WORKSHOP PRACTICE.

Properties of metals; correct use of hammer, chisel, and file; simple forge exercises; drilling, hand and power; sheet metalwork; soldering; use of stocks, dies, and taps; use of shaping machine, lathe, and brazing forge. As far as possible, the operations are combined and embodied in tools that will afterwards be useful to the students in their work.

The following is a list of tools made by students: Centre punch; flat and cross cut chisels; callipers; square; smith's tongs; pipe-grips; clips; screwdriver; nut-gauge; scribing block; small brass and copper trays; box square; depth gauge; keyway cutting; fitting feathers and keys; turning; boring; facing in lathe; screw-cutting; single, double, and triple threads; calculation of trains of wheels.

SMITHS' WORK.

Forging of hooks, keys, rings, scribers; upsetting and drawing down; welding.

METAL PLATE WORK.

The setting out of patterns for elbows formed by circular, oval, and oblong pipes meeting at any angle; T-elbows, tapering Y-pieces, bends, &c.; patterns for round, oval, oblong, and other simple forms of equal tapering bodies used by boilermakers, coppersmiths, iron, zinc, and tinplate workers; shape of notches, and allowances for lap, wire, &c., for seams of various kinds. Methods of joining sheet metal by (*a*) soldering, (*b*) riveting, and (*c*) grooving; solders and soldering; composition and uses of hard and soft solders; theory and practice of

soldering, brazing, autogenous soldering, fluxes, useful alloys, &c.; annealing, stretching, raising, planishing, and general principles of working-up sheet copper, brass, zinc, iron (plain and coated); the various hand and machine tools used in metal plate work; comparison of hand and machine tools for special work.

PLUMBERS' WORK (PRACTICAL).

Straightening sheet lead and tin, lead pipes, &c.; preparation of seams for soldering sheet lead and tin; methods of soldering sheet lead with fine, tinman's, and plumbing solder; preparation of solder, soil, &c.; preparation of joints for soldering with iron, blowpipe, and plumbing metal; joint making (copper bit, blowpipe, plumbing); caulking joints with lead and rust cement; joints of earthenware and stoneware pipes; lead working into various forms; pipe fixing; pipe bending; lead burning.

As students progress, they are encouraged to construct small engines, boilers, lathes, &c., from rough castings and forgings.

CONTAMINATION OF GAS IN HOLDERS.

It may be remembered that, at last year's congress of the Société Technique du Gaz en France, M. Guillet read a paper on "The Pollution of Gas in Holders and the Removal of Carbon Bisulphide." The paper, a translation of which was given in the "JOURNAL" for June 25, 1912 (p. 986), contained the details of a number of experiments carried out by the author which led him to the conclusion that the cause of the contamination of stored gas is the exposure of a bare metallic surface as a result of a detachment of oxide scales. Sulphuration then almost inevitably appears, and increases in intensity. When there is rust in the holder, the result is aggravated by the catalytic action. Hence no holder is free from this complication; and an initial action upon the wrought-iron plates will very probably become worse, and lead to much trouble. If the gasholder can be dispensed with for a time, the remedy, according to M. Guillet, is to empty it completely, and solder to the lower parts of the holder some sheets of zinc, each of the dimensions of one of the plates. Two or three may likewise be soldered to the plates at the bottom of the tank. If the holder cannot be put out of use, a few sheets of zinc, bent in the form of an arch, may be placed in the tank while the lifts are well up. These plates will rest on the bottom of the tank, making the contact with it which is the essence of the method.

M. Guillet's paper attracted considerable attention; and the Editor of "Le Gaz" was led to write to the author with the object of ascertaining whether subsequent experience had confirmed the results of his investigations. In reply, he furnished the following particulars. He pointed out that in his paper he showed that the gasholder on which his experiments had been made had been freed of its trouble by simply putting into the tank bent sheets of zinc, which had stopped the production of sulphuretted hydrogen. This satisfactory condition of things continued for a period of six months. About this time, however, M. Guillet's colleague in the investigations informed him that lead test-paper was beginning to show discoloration—the shade becoming deeper every day. He therefore came to the conclusion that the movements of the holder had disturbed the zinc sheets, and caused them to become slightly detached from the plates. He accordingly put in fresh sheets, with the result that the test-paper was no longer stained. He considered this was a proof of M. Guillet's hypothesis. His idea was that this relapse, so to speak, was quite characteristic. It was, he thought, perfectly understandable that only casual contact between the wrought-iron plates of the holder and sheets of zinc would tend to become less effective; the intervening water, mixed with oxide and sulphide of iron, being a powerful element of deterioration. A few days after he received his colleague's communication, the test-paper was found to be again tinged; and he said that if this continued he would again have recourse to the sheets of zinc. From the facts before him, he thought it might be concluded that the remedy indicated was effective, and that all that was required in order to render it thoroughly efficient was to bolt or solder the zinc sheets to the gasholder tank, so that their contact should be electrically perfect. M. Guillet said he was of the same opinion; and, indeed, he had indicated in his paper that this was the proper thing to do.

The electrolytic theory of the contamination of gas has been confirmed in England by Mr. J. G. Taplay, who contributed to the "JOURNAL" the results of a series of extremely interesting experiments made by him on this subject at the Tudor Street testing-station of the Gaslight and Coke Company, and published in the number containing the translation of M. Guillet's paper. Both writers are in agreement in their interpretation of the facts.

When writing to our French contemporary, M. Guillet took the opportunity of correcting an error that he made with reference to some earlier experiments carried out by Mr. Taplay, in which he stated that microbes had been found in the bend of a branch pipe supplying a testing-room, and that the issuing gas stained acetate of lead paper. The fact was that this branch, being superheated on its way to the ceiling of a gas-compressing chamber, set up in the gas the transformation of the bisulphide of carbon into sulphuretted hydrogen, and that there was never any question of microbes. M. Guillet expresses his pleasure in stating the facts, which, as he had presented them, might, he says, have been interpreted in a manner that was unjust to his English colleague.

PROTECTION OF PIPES.

The "JOURNAL" for the 4th of February contained a reproduction from the "American Gas Institute News" of an answer given by Mr. W. G. Wilson, the Secretary and Treasurer of the Master Painters' Association of the United States and Canada, to a question on the subject of the protection of pipes. In the June number of the publication referred to, he made the following remarks, bearing upon the protection of wrought-iron and steel pipes laid in soil containing salt or acid, or in any kind of soil where steel pipes require protection against corrosion.

We cannot consider this class of protective coating as in the same class as the painting of structural steel or iron work exposed to sunlight, open air, and the elements, but must consider protective coatings not affected by moisture, salt, soil acidity, electrolysis, &c. The matter of heat, cold, deflection, contraction, and expansion needs very little consideration in the matter of protecting submerged pipes. We must consider close adherence to the steel, elasticity, tenacity, thickness of coating, quick drying or hardening, and insolubility in water that is slightly acid or salt.

After carefully considering the matter, I find that in but a few cases are pipes protected by any but the dipping process, which is only a makeshift or temporary protection used principally to keep the pipes looking new until laid, and has very little protective value on account of its brittle nature. A very material saving of steel pipes could be effected by a little consideration of this matter, as I believe that materials for protection of this kind could be made at moderate cost and yet be very effective.

In my answer in the January "Gas Institute News," I mentioned a very effective paint coating to be used to protect against salt and acidity, made by the Atlas Paint Company, of Nashville (Tenn.). This I will recommend to be used as a first coat on pipes that have been dipped. It has all the qualities desired in adherence, tenacity, elasticity, &c., and is not affected by salt or soil acidity. A heavy coating is very desirable for this kind of protection; but most suitable substances will not adhere closely enough to exclude moisture if applied directly to the steel. To give the binding required, it is very important to use first a coat of a suitable paint to which a later heavy coat of a gummy substance can adhere.

Again, it is very important that a specially prepared heavy coating should be used that has been carefully and scientifically made by some experienced maker of steel protective paints. Linseed oil and paint pigments have no place in this coating. Substances that require heating to melt and apply hot are not so good as those that can be applied at a moderate temperature without heating. Some of the large gas plants have bye-products which when mixed with asphaltum of sarco gum make good heavy coatings when applied over the proper first coat or primer, but fail if applied without the binding coat of paint.

An excellent heavy coating to apply over the salt and acid resisting plant consists of 8 gallons of refined coal gas tar, 2 gallons of kerosene oil, and 20 lbs. of portland cement (or varying the amount of cement according to consistency required). The kerosene oil thins the coal tar to working consistency, and after being applied separates quickly by evaporating. The cement stops the coal tar from running, and neutralizes the acids it may contain. This mixture is being very successfully used by the railroads on bridge floors, where paint coatings of films are too thin to protect against salt brine, coal cinders, and abrasions.

ROYAL SOCIETY OF ARTS.

The Work of the Past Session.

The report which the Council of the Royal Society of Arts presented at the annual meeting last Wednesday contained, as usual, a review of the work of the past session.

Dealing first with the ordinary weekly meetings, the Council refer to the paper by Mr. Leon Gaster on "The Economic and Hygienic Value of Good Illumination." They remark that Mr. Gaster has made himself a reputation as an enthusiastic advocate of the value of ample illumination, and say the importance of the subject is proved by the success of the Illuminating Engineering Society—the special society which he has founded for its promotion. It was natural, therefore, that his paper should attract a great deal of attention, especially as it came at a time when the question of illumination as applied to factories is the subject of a special Government Commission. The author and the audience had the advantage of the presence of Sir Arthur Whitelegge, the Chief Inspector of Factories, in the chair. In 1890, Mr. Frank Bailey read a paper on "Electric Lighting Progress in London." After twenty-three years' experience, he gave the Society a second paper, dealing with a very different condition of things. The author's experience as the Chief Engineer of one of the London electricity supply companies enabled him to speak with considerable weight upon the matter; and his paper also contained the fullest information obtained from the other companies who now provide electric illumination for the Metropolis. The Council have awarded him the Society's silver medal.

The Cantor Lectures were specially interesting. The first of

the series was on "Methods of Economizing Heat," by Mr. Charles Darling, who gave in 1910 a valuable course on "Industrial Pyrometry." That of last session consisted of three lectures. The first was devoted to sources of heat, and generally to the economical combustion of fuels; in the second, the disposal of heat in various types of engine was considered; while the third was devoted to domestic heating. In it the comparative cost of heating by coal, gas, and electricity was discussed, and the various advantages of each method were reviewed. Mr. Darling's course was to a large extent supplemented at a later period of the session by that of Mr. F. W. Goodenough on "Coal Gas as a Fuel for Domestic Purposes." The two lectures of which the course consisted were illustrated by a full collection of the most modern appliances for the use of gas for heating; and a great deal of practical information, useful to all who employ gas for this purpose, was provided by the author.

The second course of Cantor Lectures was that by Professor Vivian B. Lewes, F.I.C., F.C.S., on the subject of "Liquid Fuel." Whenever the Professor appears on the Society's platform, acknowledgment is made—and justly—of the great service he has rendered; and in the report under notice it is recorded that he has already given no less than ten courses of lectures, most of them dealing either with coal gas as an illuminant or with coal as a fuel. The present course was as popular and as well attended as any of its predecessors, and the author dealt very fully with the important subject to which the lectures were devoted. He began by considering the sources, character, composition, and treatment of petroleum; then went on to deal with the various means for burning liquid fuel to the greatest advantage; and finally discussed the present state and future prospects of the liquid fuel supply, including the other liquid fuels available, besides those obtained from petroleum.

It only remains to say that thanks were accorded to the Secretary (Sir Henry Trueman Wood, M.A.) and the other officers of the Society for their services during the session.

We have received a copy of a special edition of "Energy: A Review of the German Export Industry," published by Herr J. J. Weber, of Leipzig, dealing in English with the subject of coal gas. The first article is by Dr. E. Schilling, of Munich, and is entitled "One Hundred Years of Gas Industry," and it has a portrait of William Murdoch. The other articles deal with the production of gas at gas and coke-oven works, its conveyance to the consumer, and its measurement and control. The use of compressed gas for the lighting of towns, and the utilization of residual products, have attention. Articles descriptive of the products of leading firms are given. The contents enable the reader to form a good idea of the importance and efficiency of the German gas industry. The price of the number is 1s., post free.

The report of the proceedings of the Scottish Junior Gas Association (Eastern District) in the past session has been issued. Four meetings were held for the reading and discussion of papers and five visits were paid. The pamphlet bears evidence of good work, and the report of the Council shows that the abilities of the members are recognized by the removal of several of them to wider spheres of influence. The President for the year was Mr. Alexander Bishop, of Newtongrange, whose portrait is given as a frontispiece. The miscellaneous matters consist of the list of office-bearers and members, the accounts, and the rules and catalogue of the library. The pamphlet was produced under the supervision of the Hon. Secretary and Treasurer, Mr. Lawrence Farquhar, of Alloa.

The Board of Trade have issued a notice allowing the following limits of error for continuous and single-phase alternating current electricity meters, the pattern of which has already been, or may hereafter be, approved by them. In meters in which the maximum current for full load does not exceed 3 amperes, the error at any point from one-tenth load to full load must not exceed 3½ per cent. *plus* or *minus*; and in those in which the maximum current exceeds 3 amperes but not 50 amperes, the error at any point from one-tenth load to full load must not exceed 2½ per cent. *plus* or *minus*. In those in which the maximum current exceeds 50 amperes, the error at any point from one-twentieth load to one-tenth load must not exceed 2½ per cent. *plus*, and at any point from one-tenth load to full load must not exceed 2½ per cent. *plus* or *minus*.

The Engineering Supplement to "The Times" recently contained a letter from Mr. J. S. Owens on the subject of the article on "The Future of British Fuel," which when it appeared was noticed in the "Journal." Referring to the conclusion that the carbonization of coal and the utilization of the products is in the highest degree economical, the writer said: "I would point out that the calculation given is somewhat misleading, and does not go far enough, since the products are assumed to give their full heat value when burnt. It is stated that 'nearly one-fifth of the calorific power of each ton of coal converted into ordinary gas is wasted as compared with two-thirds in the cases of domestic heating and steam raising.' If it is desired to convert the gas and coke produced into heat and utilize this, a further loss must be incurred, and the final efficiency of the whole process will be less than if the coal were burnt direct. To make the calculation correct, the table showing the calorific power of the gas and coke produced should give not only the number of British thermal units in 1 lb., but the number which can be utilized."

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

The Gas Exhibition and the Society of British Gas Industries.

Sir,—As manufacturers of specialities for light, heat, and power, we approached the Organizing Manager of the National Gas Exhibition with a view to obtaining space to show our goods. For some reason or other, we are unable to obtain either space or a reply to our letter.

Thinking that the Society of British Gas Industries was a representative body of manufacturers and others connected with the gas industry, we applied to them to become members. Our application has met with scant courtesy; and the letter from the Secretary contained these words: "The Committee is unable to entertain it" [meaning our application].

We have not the least desire to force our membership on any body of men; and possibly the greater distinction is in this instance attached to those outside its scope.

Not understanding the Organizing Manager's attitude or the attitude of the Society of British Gas Industries, we have made further inquiries, which cause us to believe that the whole of the gas exhibition arrangements, so far as exhibits are concerned, are in the hands of the few who happen to be members of the "B.G.I.," and that, seeing that they have put up so much money, they mean to run the exhibition for the benefit of themselves, and they do not want any new members until they have reaped the benefits to which they think they are entitled by having paid or guaranteed a certain sum. In other words, the "B.G.I." has cornered the whole industry so far as the exhibition is concerned.

On such lines as these, how can gas companies be asked to subscribe to the exhibition, and what is the position of the Institution of Gas Engineers and the British Commercial Gas Association, if the industry is sold for exhibition purposes to the "B.G.I."?

We think that some explanation should be speedily forthcoming as to the rights and wrongs of this. Doubtless there are two sides to the question.

We submit that a gas exhibition, if it is to be representative, cannot close its doors to anybody, and that like facilities for displaying gas industrial appliances should be open to all.

Helm Lamp Company,
per W. M. Butler, Managing-Director.

Nuneaton, June 28, 1913.

[With reference to the foregoing letter, we understand the position to be as follows: The Council of the Institution of Gas Engineers in the first instance approached the Society of British Gas Industries, with a view to securing their co-operation in the promotion of a National Gas Exhibition to celebrate the Jubilee of the Institution and the Centenary of Gas Supply. The Society responded so heartily to the invitation, and showed such readiness to sink all individual interests and rivalries, that it has been possible to arrange for a co-operative exhibition on lines that are bound to be far more interesting to the public, and therefore fruitful to the industry as a whole, than any previously organized exhibition. The members of the Society have guaranteed half of the total expenses of the exhibition.

The Society is therefore fully entitled to first consideration in regard to all plant, apparatus, and appliances required to make the exhibition truly representative of the industry at the present date; and all firms other than members of the Society applying for admission of their goods to the exhibition are rightly referred to the Society in the first instance. The Society are, and have been, anxious to use this opportunity to strengthen their membership and increase their power of usefulness in the industry, and a considerable access of membership has, we believe, resulted.

With the grounds on which the Council of the Society have refused applications for membership we have nothing to do, unless a desire to exclude duly qualified firms from co-operation in the exhibition were one of them. This, we are assured, has not been, and will not be, the case in any single instance. No policy of exclusion of firms holding a recognized place in the gas industry has been adopted; rather has a policy of inclusion been actively pursued.

The exhibition organization is not "in the hands of the few who happen to be members of the B.G.I." ("the few," by the way, being the great majority of all the established firms in the industry); it is in the hands of a Joint Committee representing the Institution of Gas Engineers, the Society of British Gas Industries, the British Commercial Gas Association, and the subscribing undertakings.

Should the Executive Committee find that, to make the exhibition truly representative of the gas industry of to-day, it is necessary to include the goods of firms who are not eligible for membership of the Society of British Gas Industries, they will do so, we feel quite sure, without hesitation, and without opposition on the part of members of that Society.—Ed. J.G.L.]

Some Reflections on Benzol Recovery at Gas-Works.

Sir,—Among the many interesting problems in the gas-works bye-product recovery field, there is one that has lately come into the foreground—namely, benzol recovery. A remarkable rise in oil prices has caused a demand on substitutes; and from many well-known points of

view it seems as if gas-works should be well able to solve the question of a suitable substitute. Thus it has been pointed out that the benzol at British gas-works would nearly fill the requirements of the motor world; and this benzol could be produced (so to speak) isolated, without getting a series of new products, that would influence the market and indirectly diminish the return.

The very first thing to consider in this connection is the effect of benzol on the heating and illuminating effect of the gas. As is well known, coal gas holds about 0·8 to 1 volume per cent. of benzol—contributing about 275 calories per cubic metre to the heating effect. By means of simple arithmetic one can, of course, always tell the heating effect corresponding to any amount of benzol. The relation between benzol and illuminating effect, on the other hand, is more complicated, because gas with a certain fixed amount of benzol would give rather different results in different burners. Published literature seems to afford few indications on this point. Without neglecting the value of candle power as a criterion of coal gas, one can yet say that the heating effect nowadays is of the greatest practical importance—as well for the producer as for the consumers; and it must always be especially interesting to analyze the benzol-recovery question in connection with the heating effect.

If the problem be analyzed in this very simplified form, the whole thing could be put in a nutshell by asking: "To what limit could benzol be washed out at British gas-works without prejudicing the public interest?" The answer to the question presumes, further, that one could determine a fair rule for the heating effect of town gas.

From a Continental point of view, this thing could be discussed (theoretically) more easily, because at the very few places where gas laws exist is the heating effect of the gas ever taken into account. Thus for Germany, Professor Bunte has formulated the rather general opinion that 5000 calories (at 0° C. and 760 mm. bar.) is normal. In the writer's country, Sweden, almost the same rule is adopted for the Corporation works in Stockholm (about 400,000 inhabitants and 40 million cubic metres production)—namely, 5000 calories at 15° C. and for the eight Swedish cities (of about 10,000 inhabitants) where the writer recently has secured concessions. Now, as with existing methods one gets a gas with 5200 or 5300 calories, one can without interfering with the public interest wash out at least two-thirds of the benzol.

The question is still open, how benzol recovery would work under British legislation, while the fact that it is quite feasible in some other countries with well-established opinion on heating effect would perhaps be useful to remember.

GUSTAF GRAF.

Stockholm, June 23, 1913.

Messrs. Smith and Walter's Institution Paper.

SIR,—In reply to the remarks made by Mr. W. Newton Booth, with regard to the paper which we recently read before the Institution of Gas Engineers, we wish to make the following observations.

In the first place, Mr. Booth does not agree that the application of the formulæ set out in the paper gives the maximum discharge, under the conditions stated. We wish to point out that what we stated was that the maximum *mass* rate of discharge would obtain under the conditions given.

Taking the formulæ for an adiabatic flow, we agree that, with an increase of the higher pressure p_0, both the velocity and volume discharge will increase; but it will be understood that higher velocities and higher volume discharges do not necessarily signify greater weight flows—the value of w_1 being diminished as p_0 increases, while the maximum weight flow exists under the conditions given.

Mr. Booth further makes the remark that experiments show that beyond the limiting condition, however much the pressure into which the discharge takes place is reduced, the pressure in the jet never falls below the limiting value. We are quite ready to agree with Mr. Booth on this point, in consideration of the fact that this condition has been found to obtain in the case of steam and air. But we did not make this assumption, as we had not verified it by experimental investigation in the case of coal gas.

Assuming this to be the case, the velocity of discharge will remain constant at the limiting value given; while the weight flow will increase directly with the higher pressure p_0.

Mr. Booth then queries the accuracy of the assumptions made in regard to the performances of injectors. We are afraid that he has misinterpreted the meaning of the assumptions made, and has taken them as being intended to represent the conditions under which maximum efficiencies would be practically obtained. We did not intend this in any way, but made these assumptions with the intention of their acting as a basis on which to compare the performances of injectors, by subjecting them to the most severe test; and we quite agree that, in practice, many of the conditions are more favourable than those assumed.

With regard to the effect of an initial velocity being given to the air, we agree that in this way the efficiency of the injector will be increased, and have made use of this fact in connection with furnaces designed for a working pressure of 5 to 7 lbs. to obtain the maximum efficiencies of the injectors. This initial velocity will, of course, depend not only on the construction of the burner itself, but also on the design of the particular furnace in which the burner is used. In the case of ring burners, however, it is found that the initial velocity which can be given to the air at the entrance to the injector is, comparatively speaking, small.

With regard to the pressure at the mouth of the jet being atmospheric, this, of course, refers to the region in the neighbourhood of the jet itself—the pressure gradually diminishing, and becoming a minimum in the throat of the injector.

With reference to the question as to whether the flow is truly adiabatic, the authors do not wish to assume that no heat is transferred to the issuing stream of gas—such conditions being impossible in practice. The results of a large number of tests, however, carried out with nozzles constructed of brass, steatite, and glass, show the condition of flow to be more nearly adiabatic than isothermal.

Mr. Booth concludes his remarks with an interesting illustration of the increased efficiency which can be obtained by giving initial velocity to the air prior to injection. This increased efficiency referred to is accounted for by the reduction which takes place in the total change of momentum of the air before and after injection when an initial velocity is given. Advantage has been taken of this fact in many cases; but the authors find that the extent to which this principle can be applied in practice will be determined by the fineness of the mixture required—it being found that the best mixing of gas and air is obtained when the initial velocity of the air is a minimum.

E. W. SMITH.
C. M. WALTER.

Birmingham, June 28, 1913.

Gaseous Heating.

SIR,—Referring to the valuable paper read by Messrs. Smith and Walter at the Institution meeting, I have equipped a considerable number of pans or pots with high-pressure gas as the heating medium for such purposes as soft metal melting, varnish, bitumen, sugar boiling, &c.; but I have always kept the injector bodies outside the burner chamber—instead of as shown in the sketch submitted by the authors—and made provision for a supply of secondary air by a supplementary channel; such channel being fitted with a door to swing outwards, but unprovided with any means of fastening.

The objects aimed at were as follows:—

(1) To obtain a supply of primary air as cold as possible.
(2) To provide a means of strictly limiting the amount of secondary air.
(3) The swinging door to act also as a safety-valve in case of the firing of an accumulation of gas through carelessness or other cause.

The wisdom of the last provision has been demonstrated on at least one occasion.

As a result of my own experience, in designing future furnaces of this description I shall, if possible, take off the products of combustion through openings placed all round the top lining of the furnace—such openings leading into a space running right round the furnace, and connected to the ordinary flue; the latter being fitted with a "butterfly" damper, such as I have always used.

It is very important that the flue dimensions are adequate, in order that there be no back-pressure in the burner chamber. But at the same time great care must be taken to see that the amount of air passing through the furnace is strictly limited, in order that the minimum heat be lost through the flues.

With respect to the "block" furnace linings, I can fully endorse all the statements made. I am rather surprised they are not used to a greater extent in the catalogued gas-furnaces as made by the various makers. I think that suitably designed blocks, held together with wrought-iron straps, would often dispense with casings, either cast-iron or wrought-iron, altogether.

R. B. A.

June 27, 1913.

Gas-Fire Construction.

SIR,—In reply to "Enquirer" [June 10, p. 748], the escaping products of combustion make themselves apparent in a similar manner as in a well-known test—viz., by forming a film of moisture on the cool nickel plated copper sheet. The latter is, of course, well polished.

EXPERIMENTER.

June 23, 1913.

Scientific Carbonization.

SIR,—It seems to me "Consistency" is unduly worried to scrape up a relationship between the East Hull charging-shoot and Mr. Settle's much-discussed patent of 1902.

Mr. Settle being now in the employ of Dessau's sub-contractors, the reason is obvious; though "Consistency" would doubtless have readers believe he was actuated only by his overwhelming love of truth.

In my letter of Dec. 10, 1912 ["JOURNAL," p. 834], I proved conclusively that Mr. Settle's patent of 1902 was the very antithesis of mine of 1908. It is not necessary for me to add anything, except to say that "Consistency," in quoting a few words only from each claim to suit his own argument, is simply telling readers "half-truths."

I would remind "Consistency" of the old adage, "People who live in glass houses should not throw stones," as it is possible that to the very patent laws he presumes to criticize he may owe much.

Readers will note that "Consistency" has carefully omitted to state where the methods of charging under discussion, with consequent low gas pressure and improved coke, were in actual use on a Dessau installation before 1908. His silence is eloquent. I will, therefore, answer for him. There was no similar shoot in 1908, because at that time the Dessau patent porous charge was obtained by screening the coal, and delivering the large and small coal in separate streams.

It is therefore beyond controversy that Dempster's intermittent vertical retorts had the privilege of first introducing these improved methods for lightly charging and automatically measuring the height of the charge, which is all I wished to emphasize.

HERBERT J. TOOGOOD.

Elland, June 23, 1913.

Coke-Oven Gas Supply in Belgium.—The proposal made by the Société des Fours à Coke de Vilvorde to supply about 530 million cubic feet of gas per annum to Brussels, to which reference has already been made in the "JOURNAL," has been the subject of much discussion by the Municipal Council, many members being against the idea. The Council will not, however, be called upon to arrive at a decision on the subject, as the Company, having entered into a contract with the Gas Company at St. Josse-ten-Noode (in the neighbourhood of Brussels) to take all the gas that can be supplied, have withdrawn their offer to the Municipality.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills :—

Bills brought from the Commons, read the first time, and referred to the Examiners: Bournemouth Gas and Water Bill, Gas and Water Provisional Orders Bill (No. 2), Liverpool Corporation Bill, Silloth Gas Bill, West Bromwich Corporation Bill.

Bills reported: Lymm Urban District Council Bill, Mid Kent and East Kent District Water Bill, Swanage District Water Bill.

Bills read the third time and passed: Bishop's Waltham Water Bill, Gas Orders Confirmation Bill, Gas and Water Orders Confirmation Bill (No. 1), Mynyddislwyn Urban District Council Bill, Worthing Gas Bill.

The North Metropolitan Electric Power Supply Company have petitioned against the Tottenham and Edmonton Gas Bill; and it has been referred to a Select Committee, consisting of Lord Newton (Chairman), Lord Silchester, Lord Wynford, Lord Lovat, and Lord Gorell, who will commence sitting to-day.

The opposition to the Westgate and Birchington Gas and Electricity Bill has been withdrawn.

HOUSE OF COMMONS.

The following further progress has been made with Bills :—

Lords Bills read the first time and referred to the Examiners: Gas Orders Confirmation Bill, Gas and Water Orders Confirmation Bill (No. 1), Worthing Gas Bill.

Lords Bills read a second time and committed: Broadstairs and St. Peter's Urban District Council Bill, Ebbw Vale Water Bill, Huddersfield Corporation Bill, Leeds Corporation Bill, United District Gas Bill.

Bills reported: Barry Urban District Council Bill, London County Council (General Powers) Bill.

Bills read the third time and passed: Bournemouth Gas and Water Bill, Heathfield and District Water Bill, Porthcawl and District Gas and Electricity Bill [Lords], Slough Gas Bill [Lords], South Staffordshire Mond Gas Bill [Lords], South Staffordshire Water Bill [Lords], West Bromwich Corporation Bill.

METROPOLITAN WATER BOARD'S DEFICIENCY.

In the House of Commons last Thursday, Mr. Walter Rea (Scarborough) asked the President of the Local Government Board whether the Metropolitan Water Board were seeking powers in the present session in connection with the levy of a deficiency rate under section 15 of the Metropolis Water Act, 1902; and also whether his attention had been drawn to a report of the Finance Committee of the Board expressing the strong opinion that the machinery of the Act is cumbersome and involved, and that the exclusion of so large an assessable value as £2,000,000 from liability to contribute to the precept is fraught with serious injustice to the remainder of the area. He further wished to know whether the powers now sought, if granted, would remove these objections; and whether he would have a return prepared showing the rateable value of each district within the water area, together with the rateable value upon which the Board propose to base the precepts for the deficiency rate. Mr. Burns, in reply, said the answer to the first two parts of the question was in the affirmative. With reference to the third part, the Bill now before Parliament did not propose to alter the incidence of the charge, which was fixed by the Metropolis Water Act, 1902. He understood that the Board were preparing a statement giving the information desired.

PROGRESS OF SUNDRY PRIVATE BILLS.

The following Bills were before various Committees of Parliament during the past week, and were sent forward for third reading.

Derby Corporation Bill.—This Bill was before the Unopposed Bills Committee of the House of Lords on Tuesday. There are a few clauses in the electrical section for the protection of the Derby Gas Company, which were dealt with at the time the Bill was before the Local Legislation Committee of the House of Commons.

Local Government Provisional Orders (No. 6) Confirmation Bill.—This Bill, which was dealt with by the Unopposed Bills Committee of the House of Commons on Thursday, includes the following Orders: (1) Burton-upon-Trent Corporation Order, which provides for the extension of the gas limits to include part of Hatton and the parishes of Rolleston, Stretton, and Tutbury, and also the taking over of gasworks in Tutbury and Rolleston now being carried on by Messrs. J. C. Staton and Co., and Sir Oswald Mosley, Bart., respectively, as non-statutory undertakings. Under the Corporation's Act of 1853, the maximum price which had been charged for gas is 7s. per 1000 cubic feet; but this is now reduced to 4s. 6d. (2) Kendal Corporation Order. This extends the limits of supply, and authorizes the use of certain lands for gas purposes. (3) Stockton-on-Tees Corporation Order, by which is authorized the use of additional land for gas purposes. (4) Torquay Corporation Order. This makes certain provision as to the gas undertaking as regards pressure, and prescribes 14-candle gas.

Local Government Provisional Orders (No. 17) Confirmation Bill.—This Bill, which was before the Unopposed Bills Committee of the House of Commons on Thursday, deals with the following: (1) Ilkeston Order, which schedules additional lands for gas purposes. (2) Scunthorpe Urban District Council Order, which extends the gas limits, and also gives powers to lay mains in the added area.

MISCELLANEOUS NEWS.

EDINBURGH AND LEITH GAS COMMISSIONERS.

Annual Accounts.

Mr. A. Canning Williams, the Treasurer and Collector to the Edinburgh and Leith Gas Commissioners, has presented to the Finance and Law Committee the draft accounts of the gas undertaking for the financial year ended May 15, 1913. In his report accompanying the accounts, he makes the following explanatory remarks.

Dealing first with the revenue account, he says that when the estimates were submitted last September it was explained, in an accompanying letter, that the increase in the sale of gas had been taken at 2½ per cent., and that a considerable improvement—upwards of £10,000—was anticipated from the sale of residuals. Both of these forecasts have been largely exceeded. The sale of gas (1,962,782,000 cubic feet) is larger by 4·11 per cent. than in 1911-12, and constitutes a record in the history of the undertaking; and the proceeds from residuals exceed those for the previous year by upwards of £22,000.

The increase in the quantity of gas sold is 77,553,600 cubic feet; and from the figures given hereunder, it will be seen that advances have been made in all sections :—

—	1912-13.	1911-12.	Increase.	
	Cubic Feet.	Cubic Feet.	Cubic Feet	Per Ct.
Ordinary consumers	1,636,726,100	1,584,025,400	52,700,700	3·33
Gas for engines and trade purposes	93,728,400	78,840,100	14,888,300	18·88
Prepayment consumers	81,055,400	73,403,600	7,651,800	10·42
Stair lights	66,581,000	66,544,100	36,900	0·05
Public lamps	82,464,200	80,372,100	2,092,100	2·60
In bulk	2,226,900	2,043,100	183,800	9·00
Totals	1,962,782,000	1,885,228,400	77,553,600	4·11

The net value of the gas sold amounts to £256,009—an increase of £10,324.

Coke has contributed the principal share of the additional revenue from residuals: but tar has helped materially :—

—	1912-13.	1911-12.	Increase.	
				Per Ct.
Coke	£45,725	£30,672	£15,053	49·08
Tar	21,471	16,023	5,448	34·00
Sulphate of ammonia	27,439	25,675	1,764	6·87
Totals	£94,635	£72,370	£22,265	30·77

The remaining items on the income side of the revenue account total £14,232, compared with £17,049 in 1911-12; the difference of £2817 being chiefly due to the introduction of free cookers and the consequent loss of rental, and to the reduction in the extra price charged to prepayment consumers. The total income amounts to £364,877—an increase of £29,772 on last year.

The expenditure side of the account, which totals to £246,883, exhibits, as was anticipated, large additional outlays. Increases are shown under the following heads :—

Coal		£15,652
Wages (carbonizing)		420
Repairs and maintenance of works and plant		3,310
Gas-fitters and general distribution charges		1,384
Repairs of mains, &c.		808
Repairs of meters		695
Repairing and fitting up cookers, fires, &c.		7,959
General establishment charges		1,379
National insurance act charges (new item)		570
Compensations		2,250
Other items		1,178
		£35,605
Deducting the decreases—		
Oil and coke for carburetted water gas	£3,286	
Purifying materials, &c.	232	
Bad debts	404	
Other items	382	
		4,304
There is shown a net increase in expenditure of		£31,301

The larger cost of coal is owing to higher prices having been paid for the material, and to a greater quantity having been carbonized; while the increase in respect of compensations is mainly due to the well-pollution case recently brought to a friendly settlement. The decrease in the cost of oil and coke used in the manufacture of water gas is accounted for by the fact that a much smaller volume of this gas was made. The bad debts (£404, or 53·15 per cent.) are less than in 1911-12, and £450 below the average of the previous five years. As the additional expenditure exceeds the additional income by £1528, the gross profit—£117,994—is less by this sum than it was in 1911-12.

Coming to the position of the net revenue account, Mr. Williams says the debits in respect of annuities, interest on loans, sinking and reserve fund contributions, &c., for the year amount to £109,865, against £110,460; thus leaving a surplus on the year's working of £8129 (compared with £9062 in 1911-12), and making, with the balance brought forward (£14,810) and the amount credited in respect of income-tax (£7639), a credit balance of £30,578, which, subject to the

approval of the Commissioners, has been carried forward to the credit of the new year, to be used, free of interest, as working capital.

The following figures summarize the year's working as compared with the previous year :—

	1912-13.	1911-12.	Increase (+) or Decrease (−).
Income	£364,877	£335,105	+ £29,772
Expenditure . . .	246,883	215,583	+ 31,300
Gross profit carried to net revenue account.	117,994	119,522	− 1,528
Charges against net revenue—			
Annuities	30,636	31,183	− 547
Mortgage interest, &c.	36,108	37,895	− 1,787
Sinking funds. . .	25,724	24,636	+ 1,088
Reserve funds . .	17,397	16,746	+ 651
	109,865	110,460	− 595
Surplus for the year .	8,129	9,062	− 933

With respect to the capital account, there was expended during the year a net sum of £12,801, of which £9768 was for gas cookers, fires, &c. Annuity stock and mortgages amounting to £63,365 were redeemed during the year, increasing the amount of extinguished debt from £285,092 to £348,457. The annuity and interest-bearing capital stands at £1,860,778, compared with £1,922,149 at May 15, 1912. Of recent years, the annuities have been redeemed on a descending scale of cost, which has effected a considerable saving to the undertaking.

PLYMOUTH GAS COMPANY.

An Increased Demand for Gas.

A large number of shareholders attended the Annual Meeting of the Plymouth and Stonehouse Gas Company which was held last Thursday, at the works—Sir JOSEPH A. BELLAMY presiding.

The report of the Directors stated that there had been an increase of 6 per cent. in the quantity of gas sold during the year ended March 31, which was very satisfactory. It was with great regret that they were compelled, owing to dearer coal, oil, and freight, to advance the price of gas 2d. per 1000 cubic feet, as from March last. From the credit balance of £33,720, they recommended payment of a dividend for the half year ending March at the rate of 6⅜ per cent. on the ordinary stock, 10s. 3d. per share on the additional shares, and 9s. 9d. per share on the new shares under the Act of 1879. This would absorb £10,581, leaving £23,139 to be carried forward. Owing to the strike of transport workers last June, the carters employed by the contractor for the conveyance of coal to the Company's stores ceased work without notice; and the Directors then decided to undertake the carriage of coal from the steamers by means of steam-waggons. This change was made in February last; and as the result there had been great economy in cost, as well as quicker despatch in clearing the ships. The strike of railwaymen in Durham last December caused great anxiety to the Directors, and a considerable loss to the Company. The co-partnership scheme, which had been in existence for the past two years, was working very satisfactorily.

The accounts showed that there had been expended during the year £6420 on capital account, of which £2328 was for buildings and plant at the works, and £4092 for stoves and prepayment meters. On revenue account, the income was £127,746, as compared with £118,395. The principal items were: Sales of gas, £91,622, against £86,331; rental of meters and stoves, £7998, against £7664; and residuals £26,208, against £22,568. The expenditure was £98,558, as compared with £89,944. The cost of manufacture of gas was £78,067, against £69,178; distribution, £8294, against £7572; rents, rates, and taxes, £4371, against £5471; management, £6042, against £5643; and co-partners' share of profits, £1147, against £1097. The balance of £29,188 carried to profit and loss account compared with a balance of £28,451.

The CHAIRMAN, who moved the adoption of the report and balance-sheet, remarked that a most satisfactory feature was the increase in the sale of gas. This had been brought about in spite of the fact that for some years past Plymouth had not been growing as it had formerly, and also in face of the strong competition of electric light. The most satisfactory feature was that the increased output was steady and continuous. From 1905 to 1908, the output of gas was practically stationary, while in 1909 it began to fall. In that year, there was a decrease of 0·33 per cent., and in 1910 there was again a decrease of about ¾ per cent. It was very small, but it looked as if the Company had reached the maximum. This had proved not to be the case. It showed, however, that they had to make bigger efforts. It had been the policy of the Company for some years to keep the plant up to date. They did not wait until plant was worn out. If it was not an economic advantage to keep it, they scrapped it, and put in something that would pay better. They organized the sales, and studied the needs of the consumers. The result of the efforts they made was that the decline was arrested, and in 1911 the sales of gas began again to increase. In that year, the output showed an increase of 2·19 per cent., followed in 1912 by a further increase of 3·77 per cent.; and this year it was 6·7 per cent. This meant that in the past year they had sold 129,000,000 cubic feet of gas more than in 1910. Equally satisfactory was the fact that they had produced the gas at less cost per 1000 cubic feet, notwithstanding that higher prices had been paid for coal and oil. Last year coal cost 11·64 per cent. more per ton than in the year before, and oil 15½ per cent. per gallon more; yet the net balance of revenue was more by 2·59 per cent. These figures spoke volumes for the work that had been done, and the efforts put forward to increase business, and were justification of the outlay in modernizing the plant and other improvements.

STRIKES AND THEIR RESULT.

The Company experienced considerable loss through the railway strike in Durham last December, which cost the gas consumers of Plymouth £1300, and the shareholders £200 more. Then there was the strike of transport workers in June. For many years the Company had had a contract for the cartage of coal from the ships to the works with a local firm, who had served them very well. A few years ago, there was a strike of carters for more wages; and, when this ended, the men entered into an agreement, one of the conditions of which was that they would not strike again under any circumstances without giving notice. One day last summer, the carters ceased work, leaving a steamer which was discharging with half the cargo on board. Demurrage loomed up ahead, and immediate action had to be taken; and so orders were given to dump the balance of the cargo on the quay. Notice then came from the freight contractors that they would not send ships to Plymouth while the strike continued; and as the Company were under an obligation with respect to the delivery of coal from the collieries, this caused a further complication. They got over this difficulty by giving a guarantee to the freight contractors that there should be no delay because of the strike. The Company were, however, under a statutory obligation to keep the town lighted; and the Directors, feeling that they could not remain at the mercy of men who might think it desirable to stop work without notice, decided to buy steam-waggons to convey the coal to the works. Five waggons were purchased, and men at the works trained in their use; and they had done their work very well indeed. By their use, the Company would save £1000 a year, after allowing for interest on the capital outlay, depreciation, and every possible contingency. Furthermore, instead of the discharging of a ship taking three days, they would be able to do it in two days; and he hoped when the new contract for freight came to be made, to effect a considerable saving by reason of this quicker despatch.

CO-PARTNERSHIP.

The co-partnership scheme had now been in existence two years, and for the first time they had present at that meeting some members of the men's Committee, who were attending in the capacity of shareholders. Up to the present, there had been distributed among the men £2933. The first principle on which co-partnership must be worked, if it was to be worked satisfactorily, was that the men must receive the standard rate of wages, and over and above this a share of the profits. What did the Company get back for it? They got back, to start with, full value for the money in good feeling between employer and employed. When they wanted men, they had the pick, because of the knowledge that they treated their employees well. The feeling must be engendered that the men were now one with the shareholders in their interest in the success of the undertaking. For many years good feeling between the Company and the workmen had been cultivated in various ways. They gave pensions to the old workmen, and they had annual gatherings of the men and their wives and children which were appreciated; while the men had been helped and encouraged in their sports by the provision of a bowling green and a rifle range. Without being asked to do it, they had increased on two recent occasions by one shilling a week the wage of the lowest paid men; and this was particularly appreciated, because it came unsought.

THE COST OF COAL AND OIL.

Mention was made in the report of the increase in the price of gas since March by 2d. per 1000 cubic feet. With the price of coal and oil rising so alarmingly, an advance in the price of gas was unavoidable. The price of oil was now certainly double what they had been paying some years back; while coal had gone up one-third since last year. They had not raised the price to slot consumers. In view of the fact that the average consumption of the slot users had increased, and the business become more profitable, they decided to let the old price remain. The Company were doing well in the sale of gas for power, which they maintained at a low price. In his judgment, it was impossible, on true merits, for any system of power to be brought into competition with Plymouth gas at the price at which it was supplied. Depreciation of their investments was an adverse factor which they had to meet year after year; and since 1908 they had, by writing the securities down to the market value of the day, carried into the balance-sheets sums amounting to £5920.

NEW PLANT.

Some additions had been made to the plant. A new oil-tank was nearly completed, and would be of advantage in enabling the Company to buy and store greater quantities of oil. By reason of the larger amount of carbonizing which was done, the purifiers were worn out, and they had to provide new ones. A very ingenious plant had been installed with the object of saving the coke hitherto thrown away with the ashes and clinkers. The cost was £900, and it would yield a profit of between £300 and £400 a year. The firm by whom it was supplied was Messrs. Head, Wrightson, and Co.; and it was known as the "Nota Nos" ash plant. In conclusion, he expressed the appreciation of himself and the Directors of the services rendered by Mr. P. S. Hoyte (the Engineer and Manager), Mr. H. B. Heath (the Secretary), and the whole of the staff and workpeople. All had worked splendidly to advance the interests of the Company. There was plenty of push, zeal, and initiative. A personal desire was manifested on the part of everyone to do the best, and to suggest improvements; and in this way the Company obtained, in his opinion, full value for all they did for those whom they employed.

The report having been adopted, and the dividends declared,

Mr. W. FRENCH, one of the workmen shareholders, proposed a vote of thanks to the Chairman for what had been done for the workmen by the co-partnership scheme. He assured the meeting that the men thoroughly appreciated the action of the Company.

Mr. G. MATTHEWS, another workman, who seconded, said the good feeling which existed all round was not the least valuable result of the Directors' action.

The motion was carried, and the Directors and officials were also thanked for their services to the Company.

After the meeting, most of the shareholders went through the works, and Mr. Hoyte explained the use of the new plant. The ash-washer and coke-saver has been erected near the large retort-house, and was found to be dealing rapidly and effectively with a large quantity of

material. The steam-waggons, each of which conveys 6 tons of coal, were also seen in use; and admiration was expressed of the ease with which they were manœuvred into position at the entrance to the coal-store, and the effectiveness of the self-tipping arrangement. In the new tank storage will be provided for 3000 tons of oil. Two purifiers, each 45 feet by 25 feet, are being erected; while provision is being made in the same house for two more when the need for them arises. Messrs. Willey and Co. of Exeter, re-built the oil-tank, which is of steel.

BRADFORD CORPORATION GAS DEPARTMENT.

Annual Report of the Engineer.

There has been presented to the Bradford Corporation Gas Committee by the Engineer and Manager (Mr. Charles Wood), his report on the working of the gas undertaking for the twelve months ended the 31st of March. It is, as usual, accompanied by an analysis of the gas accounts, compared with those for the preceding year.

Mr. Wood says that the quantity of gas sold during the year amounted to 2,064,796,000 cubic feet; being an increase on the previous year of 3·06 per cent., or the largest in any year since 1899. The net profit of £19,745 is £10,127 better than last year, and £6811 more than in the previous best year since the price of gas was reduced to its present figure nine years ago.

The chief features of the year have been the coal strike and its conquences, the continued rise in the prices of coal and of almost every other class of material used, the general advance of employees' wages, the introduction of the new method of manufacture at the Thornton Road works, and the much better prices obtained from the sale of residuals. The coal strike was settled during the second week in April; but good deliveries of coal did not come in until the following week. No coal was purchased during the strike; but the extra cost of transferring coal and replacing stocks in the summer amounted to £3200. The loss of profit on the reduced sale of gas caused by the closing of mills, &c., in April was at least £2000; while the extra labour and cartage in delivering coke in small quantities only during April cost about £600. During the month £3000 extra could easily have been realized if the coke had been sold at the then current prices.

There was a general advance last year of from 2s. to 2s. 6d. per ton on gas-coal contracts; but purchases were made upon as favourable terms as any other large undertaking. The extra price that is having to be paid on the last contracts is £18,000, of which £7800 was paid during the year under review. Allowing for the extra quantities of coal carbonized and residuals produced, the coal used cost 9d. per ton more; and there was obtained 7d. extra on coke and 6d. on tar per ton of coal carbonized.

The following table, showing the average prices paid for coal used during the past twenty years, is, Mr. Wood remarks, interesting :—

Year ended m.	Contract Prices of Good West Yorkshire Coal, Delivered.	Actual Cost of Coal used, including all Handling.
	Per ton. s. d.	Per ton. s. d.
1893	11 2	11 3
1894	10 2	12 11
1895	10 1	9 11
1896	9 9	9 8
1897	9 10	9 3
1898	9 6	9 2
1899	9 5	9 2
1900	11 1	10 2
1901	15 10	13 10
1902	12 2	11 9
1903	10 11	10 10
1904	10 5	10 2
1905	9 11	9 8
1906	9 6	9 6
1907	9 6	9 7
1908	12 0	10 7
1909	11 2	10 10
1910	10 8	10 7
1911	10 7	10 6
1912	10 3	10 7
1913	12 4	11 5

N.B.—The Yorkshire Coal Strike in 1893-4 necessitated the purchase of 27,000 tons of expensive coal from Durham, &c.

There is still a small quantity of the coal purchased in 1911 to come in; but a further advance of 1s. per ton will certainly have to be paid this year; while the values of residuals are now falling, though, possibly, only temporarily.

The all-round advances of wages would have accounted for an extra payment of £1600 to the men over the previous year. However, by the introduction of labour-saving machinery on the installation of vertical retorts at the Thornton Road works the carbonizing wages have been reduced by £3100, and at the same time the work has been rendered much lighter for the men employed.

The cost of all new services and all repairs and renewals of plant has again been charged directly to revenue. The charges for interest and sinking fund upon the goodwill alone of the various added gas undertakings amounted to upwards of £18,000 during the year. The benefit to the consumers in these districts owing to the reduction in price by the Corporation was £14,688 for the year. The total quantity of gas produced during the year was 2,203,145,000 cubic feet; being an increase of 54,920,000 cubic feet, or 2·55 per cent., compared with the previous year. The gas sold—including 167,330,000 cubic feet used in the public lamps—amounted to 2,064,796,000 cubic feet; being an increase of 3·06 per cent.

During the past year, 211,071 tons of coal and cannel were carbonized, including 95,000 tons of coal purchased very favourably in 1911. Cannel to the extent of 6·06 per cent. was used, as against 6·92 per cent. in the previous year. The average cost of the coal and cannel used—including cartage and handling—was 11s. 6·54d. per ton, against 10s. 9·53d. Mr. Wood says 297 lbs. of coal were carbonized per ordinary retort charged, or 4 lbs. less than in the previous year. As the vertical retorts at Thornton Road are charged continuously, they are excluded. The average quantity of gas made per ton of coal was 10,437 cubic feet, being 51 feet more, in spite of the fact that a much larger proportion of local and other inferior coal was used during the winter, when good coal was difficult to get.

Coming to the actual revenue account for the year, the total salaries for manufacture, distribution, and management amounted to £5910, being an increase of £87. Carbonizing wages absorbed £28,280, a decrease of £2698. Coal cost £121,849, or £10,218 more; and the expenditure on purification was £4253, an increase of £393. The sum of £30,227 was spent on repairs and maintenance of works, or £2151 more. Both these last two increases are due to extra cost of materials and advanced wages. The repairs to mains and services—including the cost of new services—amounted to £6745, a decrease of £115. A sum of £1187 was spent on repairs and maintenance of meters, or £577 less. Meter inspection cost £4047, or an increase of £139. The Finance Committee's charges for administration and collection of accounts were £1700, being the same as for several years past. Miscellaneous expenses amounted to £1145—an increase of £238. The new item of Health Insurance cost £446. Stationery cost £635, or £166 more; and bad debts, which amounted to £823, show a decrease of £84—a lower figure than for many years. The amount paid for rents (principally ground rents) was £644, or £57 less. There was paid for rates £14,209, or £5 less. The Stove Department cost £4235; but the revenue from it was £4328; leaving a balance of profit of £93, as against £251 last year, which is regarded as quite satisfactory, as a large portion of the goods are supplied to plumbers at practically cost price.

The following are the main items of income: £198,036 was received for gas, being an increase of £5698—all, of course, due to extra sales. Meter-rents produced £2696, or £13 increase. Coke yielded £48,007, or £8524 more. Tar brought in £21,567, being an increase of £5758; and ammoniacal liquor produced £23,073, an increase of £822. From the sale of spent oxide to the chemical works there was received £2394, an increase of £112. The cost of coal, less residuals (excluding profit on the chemical works), was £29,202, being £4886 better. Purification, less revenue from spent oxide, cost £1859, or £281 more. Rents received amounted to £1124, or £40 more. The gross profit on the chemical works (including the profit on the sale of ammoniacal liquor) was £4067, as against £4531.

The gross or trading profit for the year amounted to £73,954; being £10,042 more than for the previous year. Interest on loans, &c., amounted to £27,791, which is a decrease of £181. Income-tax was £133 less; while the sinking fund contribution of £27,779 shows an increase of £230. The net profit is thus £19,745, or £10,127 more than last year, and by far the largest since the year 1900. During the year the sum of £12,093 was spent on capital account. This amount is made up of £1436 on new mains, £10,511 on the vertical retort installation at Thornton Road, and £146 at the chemical works. The total expenditure on capital account to the end of the year was £1,206,220, of which £488,494 has already been repaid.

There was received the usual contribution from the Finance Committee of £27,500 towards the cost of street lighting. The gas used in the lamps works out at 1s. 2·82d. per 1000 cubic feet.

The principal items of the working results are given in the tables appended to the report. The decrease of ½ per cent. in the amount of unaccounted-for gas is, Mr. Wood says, most encouraging. Unaccounted-for gas is really the difference between the quantity of gas made at the works, as registered by the station-meters, and the registered by the consumers' meters, together with the quantity used in the lamps. It is made up of condensation, amounting to from 1 to 1½ per cent., loss by consumers' meters—which is at least 2 per cent. on the average, all to the benefit of the consumer—and the actual leakage due to corrosion and fractures of mains and service-pipes. There is no doubt that leakage proper is increasing throughout the country, for two reasons—firstly, the greater pressures that are now used to obtain higher lighting efficiency; and, secondly, the heavier motor road traffic causing vibrations and disturbances of the pipes in main roads. Much greater attention to mains and services is now required on this account. The average cost of the gas per 1000 cubic feet in the holders has fallen from 10·229d., which was a record, to 9·472d. The average illuminating power of the gas supplied during the year was maintained well above the standard, and the purity of the gas improved.

The total outstanding debt of the gas undertaking on March 31 was £717,726. The gross or trading profit made during the year was £78,954; being £6457 more than in the previous best year in the history of the department, and equal to 11 per cent. upon the actual debt. The year has, Mr. Wood concludes, been an anxious one for many gas undertakings; and twelve months ago it was thought by some members of the Council that it would be necessary to increase the price of gas in Bradford. The Committee therefore must, he is sure, be highly gratified that the results are so good, especially when others have had to advance the price of gas and draw upon reserve funds in order to pay full dividends.

The following are some of the items from the working statement for the past year; the figures for 1911-12 being given for comparison :—

	1911-12.		1912-13.
Coal and cannel carbonized, tons	206,834	..	211,071
Gas made, thousands of cubic feet	2,148,225	..	2,203,145
,, per ton of coal, cubic feet	10,386	..	10,437
Gas accounted for, thousands of cubic feet	2,003,418	..	2,064,796
,, ,, per ton of coal, cubic feet	9,686	..	9,782
,, ,, per cent. on make	93·26	..	93·72
Coke and breeze saleable, tons	90,101	..	94,850
,, ,, per ton of coal, cwt.	8 71	..	8·98
Tar made, tons	12,831	..	12,939
,, per ton of coal, gallons	12·09	..	11·95
Liquor made, tons	26,853	..	27,675
,, ,, per ton of coal, gallons	28·36	..	30·71

The analysis of the accounts shows that the net cost of gas was

£119,081, or at the rate of 13·841d. per 1000 cubic feet of gas sold, compared with £123,426, or 14·786d. per 1000 cubic feet sold in 1911-12. The net profit last year, as shown above, was £19,745, compared with £9618 before; the rates per 1000 cubic feet of gas sold being respectively 2·295d. and 1·152d.

GAS MEN AT THE CRYSTAL PALACE.

The centenary festival that the Gaslight and Coke Company's men, with wives and sweethearts, held last year at the Crystal Palace was such a success in more ways than one that it would have been a great pity if something could not have been done to have an annual *réunion*—if not of all the men, of part year by year. We believe strongly in the efficacy of annual outings of the kind, properly organized and conducted, in cultivating and maintaining a closer union and *esprit de corps* among large bodies of men in one employ. To have annual repetitions of such gatherings as the centenary one, however, was altogether out of the question; and so it has been arranged to have yearly about one-third of the men at the Palace on Sydenham Hill, with wives or wives-elect, to tea, combined with annual sports and a flower show, in both of which there can be the happiest rivalry, and contest for prizes. One-third means a large gathering, as was proved by last Saturday's experience; for there were, we believe, between 7000 and 8000 men and their ladies at the Palace—all enthusiastic and all happy. The flower show opened at two o'clock in a large marquee adjoining the sports ground, and the sports commenced at three, up to which time special and ordinary trains were bringing the men and their ladies from North, East, and West London. Observed among the men at different times and places were Mr. D. Milne Watson, the General Manager, Mr. T. Goulden, the Chief Engineer, Mr. H. Rayner, the Secretary, Mr. F. W. Goodenough, Controller of Gas Sales, Mr. Percy Adams, Chief of the Rental Department, Mr. E. E. Rudge, station engineers, and numerous members of the staff. They were immense tea parties that were served in the Garden Hall, Popular Room, and Restaurant, between the hours of 3.30 and 5.15. Happening on Mr. Goodenough on his way to presiding over one of the tea parties, the writer joined him. In the one spacious dining-room there must have been 1500 sitting down to tea at small separate tables; and they were a joyful lot. It was a well-served "high tea"—a substantial plate of meat, bread and butter, plain and fancy cakes, and tea. The waiters and waitresses made all feel that the good things provided were at unrestricted command. The thoughtfulness of the organizers had also made due provision for mothers with babies in arms. There was no necessity for debarring these mothers from the pleasure of the outing; for a *crèche* was provided, attractively decorated inside, where, without charge, infants could be left in the care of experienced nurses.

After tea, the writer walked through the grounds, everywhere meeting men wearing their centenary medals. A visit was paid to the flower, vegetable, and fruit show; and the competing growers must be heartily congratulated on their choice exhibits. There were fine flowers of many descriptions; and vegetables and fruit of the first order. There were also non-competing exhibits. A magnificent collection of flowers from the gardens of the Governor (Sir Corbet Woodall) was seen; and Mr. T. Goulden demonstrated that he has other interests besides those that are purely professional. There was a collection of beautiful roses on view bearing his name as a non-competing grower. The Sulphate of Ammonia Committee, too, occupied one end of the marquee with a display of some fine flowers—varied in description, large blooms, and of rich colours—together with fruit, which wealth of result, the affixed cards informed the visitor, had been obtained by the aid of sulphate of ammonia.

Then a visit was paid to the sports ground to witness some of the events there. The sports started at three o'clock; and they continued without interruption until close upon eight o'clock—music being performed by one or other of three bands: The Stratford Station Military Band, the Kilburn Prize Band, and the Rangers' Band. The events were numerous; and the contests were carried out with excellent spirit—the onlookers cheering enthusiastically the victors who upheld the athletic dignity of their respective stations or departments. Messrs. W. W. Parnham and W. J. Pepper were the Joint Hon. Secretaries to the Sports Committee. About eight o'clock, the winners and their friends gathered round a table (situated near the grand-stand) richly laden with prizes. Mr. Milne Watson and Mr. Goulden addressed those present, congratulating all on the fine weather that had been experienced for this first annual sports meeting and flower show, and complimenting the victors. The prizes were gracefully handed to the winners by Mrs. Milne Watson; and afterwards there were the heartiest of thanks to her for her kind offices, and to all who had contributed to the enjoyment of the day. The band played the National Anthem; and until some time later, the pleasures of the Palace were being enjoyed by many who are proud to own allegiance to the Gaslight and Coke Company.

A Mishap at Huddersfield.—There was a mishap in connection with the purifiers at the Huddersfield Corporation Gas-Works during the afternoon of last Sunday week, whereby sulphuretted hydrogen was passed direct on to the town. On the following morning, when the workpeople commenced at the mills, &c., this was at once apparent, and many refused to continue working till the conditions were changed. The displacing of the impure gas in the mains occupied several hours.

A Water-Main Burst and Gas Explosion.—The bursting of a 14-inch water-main at Wednesbury last Friday so disturbed the roadway as to lead to the fracture of the gas-main; and a gang of men were promptly set to work to repair the damage. While, however, the roadway was being opened up for this purpose, a spark from a pick ignited the escaping gas, and as a result two men who were assisting at the job had to receive medical treatment. The flames were extinguished by throwing the earth back again into the trench; and after an interval opening-up operations were re-started. A number of houses were flooded by the water.

PUBLIC STREET LIGHTING AT NOTTINGHAM.

We learn from our Nottingham Correspondent that, thanks to the much-needed adoption of new gas appliances, the cause of criticism which has too long obtained in relation to the poverty of the city's street-lighting arrangements is gradually being removed. He writes: Having regard to the large area to be dealt with, and the former somewhat tardy policy of the responsible Committee, the progress hitherto has not been great; and Nottingham has suffered by comparison with some neighbouring towns. But the Lighting Committee of the Corporation has not been entirely to blame for the delay. To keep within reasonable limits the ever-expanding municipal demands, estimates of local expenditure have of late years been rigidly cut down; but in respect to the indispensable nature of its work this particular department of Nottingham's municipal responsibility may be said to have suffered through a process of false economy. Streets in many of the suburban districts have never been well lighted; while in several of the central thoroughfares the illuminating arrangements left something to be desired. The fault for a long time was one entirely of neglect of up-to-date methods. There was till a comparatively recent period an inexcusably protracted reliance upon archaic methods. But this policy has now been changed; and people are loud in their praises of the alteration so far effected. Among routes which have been dealt with is the long stretch of roadway on the Gregory Boulevard, skirting Nottingham Forest, and extending from the Mansfield to the Alfreton Road end, along the whole of which there was an installation, with admirable results, of new inverted burners. Three types of lamps are being experimented with in connection with the new departure; and of these the Podmore incandescents have, so far, met with the largest measure of acceptance, both on the score of illuminating results and economy of working. Each of the lamps so equipped contains two burners of 90-candle power each. The other processes which are being experimented with by Mr. W. A. Carter, the Corporation Lighting Inspector, also include the productions of Messrs. Falk, Stadelmann, and Co., Limited, and Messrs. D. Anderson and Co.

WIGAN CORPORATION GAS UNDERTAKING.

Engineer's Annual Report.

The Gas Engineer and Manager of the Wigan Corporation (Mr. Fred Betley) has presented to the Gas Committee his report for the year ended the 31st of March last. He says there was a steady increase in the output of gas, which would have been greater had the supply not been somewhat restricted as a result of the strike in the coal trade. There was the usual record of damaged mains and service-pipes resulting from subsidence; but the unaccounted-for gas was rather lower than in the year 1911-12. The gross profit was £31,533, and the net profit £7355. The public lighting of the borough, which is done free, cost £5493. This added to the net profit makes a total of £12,848 as the total for the year. The quantity of coal carbonized was 39,709 tons, and 75,276 gallons of gas oil were used. The make of coal gas was 453,981,000 cubic feet; of carburetted water gas, 37,627,000 cubic feet—together, 491,608,000 cubic feet, or 4,623,000 cubic feet more than in the preceding year. The consumption through prepayment meters was 84,811,100 cubic feet—an increase of 2,847,800 cubic feet, or 3·35 per cent. The coin-boxes are used as depositories for savings; and last year no less a sum than £168 14s. 9½d. was handed back to the consumers, compared with £48 6s. 4d. in the year 1911-12. The quantity of gas used for cooking and heating purposes was 49,450,200 cubic feet, and for motive power 26,085,400 cubic feet—together, 75,535,600 cubic feet; being an increase of 1,563,200 cubic feet, or 2·06 per cent. The residual products per ton of coal were: Coke and breeze, 15·51 cwt.; tar, 12·84 gallons; and ammoniacal liquor, 33·36 gallons—the make of sulphate being 27·13 lbs. per ton. The capital invested in the works at the close of the year was £224,039; being equivalent to £5 6s. 1d. per ton of coal, 9s. 1d. per 1000 cubic feet of gas made, and 9s. 8d. per 1000 cubic feet sold.

SMETHWICK CORPORATION GAS UNDERTAKING.

The Past Year's Working.

In the "JOURNAL" for the 3rd ult. (p. 687), the results of the working of the gas undertaking of the Smethwick Corporation in the past financial year were briefly noticed. Some further particulars are furnished by the report submitted to the Gas Committee by the Secretary (Mr. W. J. Sturges).

There was no additional expenditure on capital account last year, so that the amount remained as before—viz., £217,048. The revenue account shows that the year was one of increasing prosperity. The total income amounted to £80,289, against £71,273 for the preceding year; being an increase of £9016, of which no less than £7578 was due to residual products. The income from sales of gas was £57,222—an increase of £1571. The reduction in prices to all classes of consumers which took effect from midsummer last came to £3362. The total quantity of gas sold and accounted for was 543,076,500 cubic feet. Compared with the sales in 1911-12, this shows an increase of 48,823,400 cubic feet, or 9·88 per cent. The gas unaccounted for was 35,145,500 cubic feet, or 6·08 per cent. of the quantity sent from the works, against 5·38 per cent. before. The collections from prepayment meters numbered 99,685, and averaged 3s. 11d. per collection, against 3s. 10d. in 1911-12. The average amount collected per meter for the year was 41s. 3½d., against 40s. 9d., with an average consumption of gas per meter of 14,588 cubic feet, against 13,269 cubic feet—an increase of 1319 cubic feet. The number of meters fixed at the end of the year

was: Ordinary, 3904; prepayment, 9695; total, 13,599, or 645 more than in 1911-12. The number of cooking-stoves fixed on hire was 3184—an advance of 834; and the number of griller stoves fixed free of charge to prepayment consumers was 3772, or 2890 more.

The total expenditure on trading account was £57,020, or an increase of £5902. The manufacture of gas, including the maintenance and renewal of works and plant, cost £43,570, which is £4963 higher than in 1911-12, and works out at 1s. 6·09d. per 1000 cubic feet of gas made, against 1s. 5·72d. before. This would have been greatly exceeded had the department experienced the full effect of the present high prices of coals. But, owing to the foresight exercised in buying extensively before the rise took place, it is only just beginning to be felt.

The gross profit on the year's trading was £23,269, compared with £20,156—an increase of £3113, notwithstanding the reductions in price, amounting to £3362. The balance standing to the credit of the profit and loss account at the commencement of the year was £7108, to which is added the gross profit of £23,269. After making provision for interest on loans and the redemption and extinction of debt, amounting in the aggregate to £10,560, there is left a net profit for the year of £12,709—an increase of £1995. After deducting £4349 for public lighting, contributed by the department in aid of the district rate, a balance of £8360 has been transferred to the credit of the extensions fund account; leaving £7108 to be carried forward as in previous years. The debit balance at the commencement of the year was £5979; and further expenditure on account of extensions and replacements to works and plant, &c., amounting in the aggregate to £7745, has been added. Deducting the amount transferred from the balance of net profit, £8360, there remains a debit balance of £5365 still to be liquidated.

A working statement accompanying the accounts shows that the quantity of coal and cannel carbonized last year was 42,906 tons, and that the total make of gas was 578,014,000 cubic feet, or 12,587 cubic feet of coal gas per ton. The residuals produced per ton were: Coke and breeze, 12·18 cwt.; tar, 9·93 gallons; and ammoniacal liquor, 31·33 gallons, compared with 24·05 gallons in 1911-12.

WORKINGTON GAS-WORKS EXTENSIONS.

Local Government Board Inquiry.

At the Town Hall, Workington, on the 20th ult., Dr. A. W. Brightmore, M.Inst.C.E., held an inquiry, on behalf of the Local Government Board, with reference to an application made to them by the Corporation for sanction to borrow £7500 to defray the cost of extending and improving the gas-works.

The Town Clerk (Mr. J. Warwick) explained that the £7500 was made up as follows: Purification plant and alterations to holder, £6232; revivifying shed, £270; purchase of land, £950; contingencies, £48. He stated that the gas-works were in the best financial position of any in the United Kingdom, and the price of gas was extremely low.

Alderman *Hall*, the Chairman of the Gas Committee, said the increased storage would enable them to work their plant more economically, and give a little more security in case of stoppage from any cause. They had no water-gas plant to fall back upon to pull them through any emergency. The price of gas was at present 2s. 2d. per 1000 cubic feet for ordinary purposes, 1s. 10d. for power, and shortly it would be 2s. and 1s. 9d. These prices would compare favourably with those of any works of a similar size in the kingdom. They were surrounded by many populous villages, and already, for the past two years, conversations between their authorities and the Council had taken place, and the Council were desirous to put themselves into the position of being able to deal with the present demand and any extension which might reasonably be expected to take place in the near future.

Mr. *E. G. Hutchinson*, the Gas Engineer and Manager (who is now in the service of the Carlisle Corporation) stated that the present total practical working storage was about 580,000 cubic feet; and the make of gas in the past financial year was 114¾ million cubic feet, compared with 62 millions in 1897—an increase of 85·16 per cent. The capacity of portions of the plant was 20,000 cubic feet of gas per hour; and the average hourly consumption from dusk to ten o'clock was about 40,000 cubic feet. It was therefore necessary, at the period of the year when the hours of daylight were short, to have in reserve a supply of gas sufficient to meet the demand. Having given particulars as to the restricted capacity of the manufacturing and purifying plant, Mr. Hutchinson said he estimated that the proposed two additional purifiers, in conjunction with the present ones when altered, would be equal to dealing with a million cubic feet of gas per day—the quantity for which the Gas Committee had instructed him to design.

Brighton Water-Works.—The statement of accounts of the Brighton Corporation water undertaking for the year ended March 31 shows a net profit of £4327. A year ago, the profit was £5116. Of the amount now realized, £2500 has, in anticipation, been already allocated to the district fund in the estimates for the current year, so that the balance to be carried forward is £1827.

Llanddulas Water Supply.—Considerable interest exists locally in regard to the question of the water supply of Llanddulas, which is in the area of the St. Asaph District Council. The Rhyl Council have offered to supply the village at 1s. per 1000 gallons, on condition that the Llanddulas Council provide a 4-inch main and storage-tank, which would entail a cost of about £2000. This charge is considered to be high, and an effort is being made to get the Rhyl Council to supply at 9d. per 1000 gallons. An alternative idea is to have a totally separate scheme for Llanddulas, by constructing water-works to obtain the necessary supply from the River Dulas. It is estimated that the cost of this scheme would be quite £5000, which would be a very serious burden on the ratepayers; and it is anticipated that the less costly one will be adopted.

NOTTINGHAM GAS EMPLOYEES' OBDURACY.

Hopes which had been built upon the Mayor of Nottingham's well-intentioned intervention in the dispute now affecting a section of the gas employees in the city have been doomed to disappointment. The men on strike at the gas-meter repairing shops of the Corporation continue in an obdurate humour, and last week rejected a possible solution of the difficulty involved in the suggested reference of the case to arbitration. It had been anticipated that the influence of other sections of trade unionists indirectly concerned in the controversy might have a pacific effect; they being understood to originally entertain a view favourable to the acceptance of the Mayor's plan. But, backed by the National Amalgamation of Sheet Metal Workers, the tinsmiths have taken up an irreconcilable attitude—adopting the dogmatic air that, after the formulation of their demands, there is nothing to arbitrate about. As a condition precedent to resuming operations they still insist upon the withdrawal of non-union labour from the Woodborough Road depôt.

Last Tuesday, a meeting of the representatives of the whole of the manual workers concerned in the various Corporation departments was held, when a united front was again presented, and a further official pronouncement was launched for the consideration of the Corporation, raising the entire question of the recognition of the principle of organized labour. The tinsmiths having made it plain that they were in no mood for further dallying, the boasted solidarity of the trade union ranks had necessarily to be demonstrated, with the result that the scheme of action was enlarged. Mr. G. Thundercliffe, Secretary of the Trades Council, supplied at the close of the deliberations the following official report: "A meeting of eighteen trade unions whose members are employed by the Corporation considered the whole aspect of the question and the position of the tinplate workers in their dispute in connection with the Gas Committee. They have agreed that the Mayor be written to, thanking him for his suggestions, and explaining that they were not acceptable to the trades concerned. At the same time a request will be sent to him to convene a meeting of the City Council at a later date. In the meantime, an appeal will be sent to the various Executives of the unions concerned, asking for powers to be given to the local branches of their unions to ballot the members upon the question of a minimum wage and the exclusive employment of trade union labour by the Nottingham Corporation."

After the men's refusal to accept the moderate course suggested by the Mayor, there appears to be little reason to expect his acquiescence in the idea of convening a special meeting of the Council to consider the matter. It appears probable therefore that the tinsmiths are likely to remain for a considerable time longer in the doubtful enjoyment of enforced inactivity. Meanwhile, the threat of stopping the repairing of Nottingham Corporation meters to whatever shops they may be sent in the country has had no effect upon the Department's ability to cope with demands.

Not unnaturally, considerable regret at the failure of the negotiations has been expressed by the Mayor (Mr. T. Ward), who has since caused it to be made publicly known that, in putting forward his suggestion, he was acting with the full approval of the Gas Committee. His Worship has not hesitated to declare his strong conviction that the Committee have acted throughout most fairly in the matter; and this has not been a very palatable pronouncement to the trade unionists, who have been wont to look upon the present occupant of the civic chair as being, apart from his official position, very closely in sympathy with labour movements. The Gas Committee, he observes, has all along been anxious to bring about a settlement. They did not want to quarrel with the trade unionists; and his opinion is that the men, by refusing arbitration, have weakened their case. The Mayor's attitude reflects pretty accurately the general feeling of members of the Council, who recognize that this interference with the management of municipal trading concerns has been already allowed to proceed to undue lengths.

It was not reasonable to imagine that the Gas Committee could be content with an indefinite prolongation of the embargo placed upon a necessary department of its work. A decision was come to at a meeting on Friday which is in the nature of an *ultimatum* to the men; and if there is now to be a continuance of the struggle, it will be interesting to watch if a Corporation can be defied in this way. It cannot be said that negotiations with a view to a settlement have erred on the side of precipitateness. All possible conciliatory methods have been resorted to by the representatives of the Corporation; and the Mayor's intervention as a last resort having also proved abortive, the Gas Committee indicated at their last meeting the determination to take decisive measures—causing a communication to be forwarded to Mr. J. O. Gordon, the General Secretary of the National Amalgamation of Sheet Metal Workers and Braziers, in which the Town Clerk (Mr. W. J. Board) pointed to the fact that the men have now been out for seventeen weeks, and had refused to return to work, notwithstanding that they had on more than one occasion been informed that they were at liberty to do so. The Town Clerk added that the Committee have no desire to dispense with the services of the men; but, in the interests of the work and the public, they cannot allow the matter to drift on. He concluded: "I am instructed, therefore, to say that the shop is still open, and the Committee will be glad if the men will return to work; but unless they do so not later than Monday, July 7, the Committee will have no alternative but to fill their places." A copy of the official communication was also directed to be sent to the Secretary of the Nottingham Trades Council, the local Secretary of the Amalgamation, and to each of the men concerned. Whether the latter will now be disposed to view the matter in a new light will be shown in the course of the next few days at a meeting which Mr. Gordon will probably attend.

Consequent upon the Committee's firm attitude, various sections of Corporation workmen, whose help as trade unionists had been appealed for in support of the tinsmiths, affect to be in high dudgeon. The question of a general strike in sympathy with the members of the National Amalgamation of Sheet Metal Workers' has been revived, with special reference to the possible decision of the larger body of gas-workers acting under the ægis of the National Union of which Mr. W. Thorne, M.P., is the Secretary. There has already been authority

given to the Local Committee by the Central Executive to ballot the men on the subject of ceasing operations in sympathy with the tinsmiths; and if the result should be in accordance with the heated talk which has attended the controversy, there may be stormy times ahead.

WAGES OF SYDNEY GAS WORKERS.

Increase of a Shilling a Day.

The Gas Employees' Wages Board, of which Mr. Neville G. M'William is Chairman, have made their award in connection with the rates of pay for employees in the works of the Sydney Gas Companies. The Chairman prepared a lengthy judgment, in which he discussed lucidly the cost of living, which was the basic principle upon which the employees asked for an extra 1s. a day in their wages. He quoted judgments given in two similar cases by Mr. Justice Heydon, and reviewed the evidence called on behalf of both sides and the Crown, which intervened on behalf of the public; and he said he had formed the opinion that the cost of living had increased by at least 12½ per cent. In conclusion, he said he desired to place on record the public-spirited manner in which the gas companies had fought the men's claims. He could but assume that the industry was prosperous, as the companies did not attempt to raise the point of their inability to pay the increased wages, and there was not the slightest suspicion of any agreement with the employees in opposition to the public.

In the course of his judgment, the Chairman said: Seeing that each case must be governed by its own particular circumstances, I think that for those employees in the lowest grades—I mean labourers—and in consideration of their work, they are entitled to something more than a bare living wage; and I have awarded it. After dealing with each class of work on each particular basis, and the evidence of extra skill, and the wear and tear on clothes, I have therefore decided that other classes of men are entitled to an increase of 1s. per day on their present wage, excepting in the case of certain youths on whom the ordinary family responsibilities do not fall. The men in the carburetted water-gas plant at Mortlake I award 6d. a day increase.

No employee who at the date of the award is receiving a higher wage for the work he is performing than is therein specified is to be reduced in wage merely as a consequence of the award. It came into force on publication in the Government "Gazette," and will remain in force until Sept. 21, 1914.

The award will entail an additional expenditure of £30,000 on the Australian Gaslight Company alone. The other companies concerned are the North Shore and the Manly.

In the course of some comments on the award, the "Sydney Morning Herald" said: As far as labour is concerned, the decision of the Wages Board awarding an increase of 1s. a day to gas workmen closes one of the most disgraceful incidents of our industrial life. To the public as a whole the incident will be closed when the Court decides whether the gas companies shall be permitted to put up their rate once again to 3s. 9d. per 1000 feet. The application to increase the rate is a corollary to the increased wages. Strikes we have always opposed as being a barbarous way of settling disputes, akin as they are to the warfare of nations. But a strike against an employer, which was the only class of strike countenanced by the old trade unionist, is infinitely preferable to a strike against the law, which is what the upheavals lately disorganizing our trade and traffic have been. The New Unionism makes an appeal court of itself. It appeals to the law; and when the law does not satisfy, it goes beyond the law, and uses Labour's primitive weapons of offence. On the other hand, the employer has hitherto been bound by the law, because the law can easily strike him. He has given hostages to the law, and those hostages may be—indeed, there is no doubt that they would be—heavily penalized, no matter what Government was in power. But the workman may strike with impunity. Even if he is fined, he is not affected directly, because we are now told that his union will pay the fine.

The New Unionism may rejoice that this decision of the Wages Board in the gas workmen's case has created a precedent which will allow any body of men who want higher wages to strike during the currency of an existing award, so as to force on the Board a new consideration of the case, with the understanding that higher rates are to be granted. The New Unionism will not be long in finding that the precedent may be used against the interests of workmen. In commercial life, a contract is considered sacred; and the law upholds this view of a contract. Now the employer has it in his power to say: "My workmen are allowed to break their contract with us when the markets move against them. Why may I not break the contract when the markets move against me?" If an employer experiences a diminution of his expected profits because the cost of material has gone up, he has now the encouragement of the example of Labour to decline to pay the wages awarded by law until that decision is re-heard by the Wages Board. While any profit at all is being made, no employer, perhaps, would take such a drastic step; but with the encouragement lately received from Labour, the temptation to break the contract in case of positive loss would be well-nigh overwhelming. Recent decisions of Wages Boards show that the cost of living is the main factor considered in the fixing of rates of pay. What, then, is to happen when the cost of living remains at its present high rates, and many employers find their profits vanish? Such a contingency is not improbable. No Board or Court can compel them to work at a loss. Then will come the supreme test of State industrial legislation; and upon the attitude Board and Unionism take depends the existence of that legislation.

Battersea Public Lighting.—The Battersea Borough Council have accepted the offer of the Gaslight and Coke Company to adapt 17 upright incandescent gas-lamps for inverted incandescent gas-burners, and to provide five additional lamps of the same type and one double inverted incandescent burner lamp free of cost to the Council, subject to the lamps remaining in lighting for a period of five years; the annual charge for the maintenance, &c., of the single-burner lamps to remain as at present—viz., £2 16s. 1d. per annum—and for the double-burner lamp to be £4 per annum.

THE SADLER MEMORIAL AT MIDDLESBROUGH.

Unveiling the Statue.

There was considerable rejoicing at Middlesbrough on Saturday, the 21st ult., on the occasion of the unveiling of the statue of the late Sir Samuel Sadler, which has been erected in Victoria Square by means of a "shilling subscription" started by the "North Eastern Daily Gazette." It is the work of Professor Lanteri, who, though not having personally known the subject of it, has produced a life-like representation of Sir Samuel as he appeared towards the closing period of his life. He is shown in his Mayoral robes and wearing his chain of office. The statue is of bronze, of light colour, while the stonework is Peterhead granite of a beautiful red shade. On the pedestal is affixed, in bronze, the armorial bearings of the borough, and underneath is the inscription: "Sir Samuel Alexander Sadler, Knight, V.D., 1842—1911." A bronze tablet on the right of the monument records that

> "This Monument was Erected by Public Subscription to Commemorate a Career Devoted to the Service of the Community. Unveiled A.D. 1913."

On the left is a similar tablet inscribed as follows:

> "Sir Samuel Sadler was a Member of the Town Council of Middlesbrough 1873—1911, Mayor 1877—1896 and 1910, Member of Parliament for Middlesbrough 1900—1906. He served in the Volunteer and Territorial Forces 1860—1911, and as Colonel and Hon. Colonel of the 1st V.B.D.L.I. and 5th Durham L.I. 1876—1911."

The total height of the statue and pedestal is 20 ft. 1 in. The statue is 3 ft. 3 in., the plinth 4 inches, and the pedestal 11 ft. 6 in. high.

The ceremony of unveiling the statue was performed by Colonel Seely, the Secretary for War, in the presence of a numerous and distinguished company, which included Lady Sadler. He was introduced by the Mayor of Middlesbrough (Alderman Mathson), who was accompanied by the Mayoress. Colonel Seely referred in the highest terms to the life-work of Sir Samuel Sadler—alluding specially to his scientific attainments, his career as a citizen, as a Member of Parliament, and as a Volunteer; and he concluded by saying his life had been a lesson for all. He then unveiled the statue, amid much cheering; the band of the 5th Durhams playing a few bars of Chopin's "Funeral March," and the "Last Post" being sounded by the buglers. Then followed a general salute.

Sir Hugh Bell, in the name of the subscribers, invited the Mayor to accept the statue; and his Worship, on behalf of the town, complied—remarking: "We all knew Sir Samuel and loved him." Mr. Stanley Sadler acknowledged the honour conferred upon Middlesbrough by the visit of Colonel Seely, and, speaking for his mother, brothers, and himself, thanked the subscribers to the memorial and the Executive Committee who had carried the proposal through. Sir Robert Ropner proposed a vote of thanks to Colonel Seely, who acknowledged it. Other speeches followed; and the proceedings closed with the National Anthem and cheers for the King and Queen.

The event calls for record in the pages of the "JOURNAL" from the fact that the late Sir Samuel Sadler was well known to people engaged in the gas industry, and especially to gas engineers and managers in the North of England, of whose Association he was President in 1894. During his presidency, the members were afforded an opportunity of inspecting the coking plant, on the Simon-Carvès system, which had been introduced at his collieries at Malton, at a cost of £32,500. These were the largest ovens of the kind which had then been erected.

HIGH-PRESSURE GAS LIGHTING IN ALDERSHOT.

The announcement is made by the Aldershot Gas, Water, and District Lighting Company, to the tradesmen of Aldershot Town, that in readiness for the next lighting season a scheme of high-pressure gas lighting will be introduced. The Company are prepared to instal the high-pressure gas-lamps free of all first cost to the consumer, supply all necessary gas, labour, mantles, &c., and maintain the lamps in good lighting order, by agreement, at the following inclusive charges:

Candle Power.	Two Winter Quarters.	Two Summer Quarters.	Per Annum.
	£ s. d.	£ s. d.	£ s. d.
1500	2 5 7	1 2 9	6 16 8
1000	1 13 1	16 6	4 19 2
600	1 8 2	14 1	4 4 6
500	1 1 2	10 7	3 3 6

The lighting and extinguishing periods are: Three nights per week half-hour after sunset to 8 p.m., one night per week to 9 p.m., and one night per week to 10.30 p.m. throughout the year—Sundays, Wednesdays, and public holidays only excepted. Extra lighting hours are also quoted for on moderate terms. A number of streets are already scheduled for the high-pressure service; and these will be added to from time to time as may be necessary.

The following copy of the agreement to be made between the parties has been forwarded by Mr. R. W. Edwards, the General Manager of the Company.

ALDERSHOT GAS, WATER, AND DISTRICT LIGHTING COMPANY.

HIGH-PRESSURE LIGHTING.

AGREEMENT made the day of 191 between the Aldershot Gas, Water, and District Lighting Company,

whose chief offices are at Victoria Road, Aldershot, in the County of Southampton (hereinafter called the Company), of the one part, and of
Aldershot aforesaid (hereinafter called "the hirer") of the other part, whereby it is agreed as follows:

1.—The Company agree to let on hire, and the hirer agrees to take on hire, for a period of not less than years from the date of fixing the following fittings for gas—namely, candle power lamp fitted complete with suitable bracket arm and safety chains.

2.—The Company agree to fix the said lamp for use from or quarter day following date of agreement, keep same clean and in good repair, to renew the mantles and globes as and when necessary, and to light and extinguish the lamp at the times hereinafter provided throughout the currency of this agreement.

3.—The Company agree to supply gas at increased pressure to the said lamp during the whole of the time during which the same are alight.

4.—The Company shall light the said lamp every night during the currency of this agreement (if required), Sundays, Wednesdays, and public holidays excepted, at about half-an-hour after sunset.

5.—The Company shall extinguish the said lamp at the following times: On Mondays, Tuesdays, and Thursdays at 8 p.m. On Fridays at 9 p.m. On Saturdays at 10.30 p.m.

6.—In consideration of the above, the hirer shall pay to the Company for each lamp supplied to him the following remuneration—namely: For each quarter ending on Dec. 25 or March 25, the sum of pounds shillings (£), and for each quarter ending June 24 or Sept. 29 the sum of pounds shillings (£), making a total of £ per lamp per annum.

7.—If the hirer shall request the Company to light the lamps earlier or to extinguish them later than the times above mentioned, or to cause the lamps to be lit on a Sunday, Wednesday, or public holiday, he shall pay to the Company the sum of per lamp for each hour or part of an hour during which the lamp shall be alight on any day other than on the days between the times above mentioned.

8.—The payment of the sum payable hereunder shall be due at the end of one week from the sending in of the account for the same.

9.—After the expiration of the above-mentioned period of three years, this agreement may be determined by either party hereto by giving to the other not less than three months' notice in writing.

10.—The Company shall be entitled to determine this agreement by giving notice in writing of their intention so to do—

(*a*) If the hirer shall make default in the payment of any sums due to the Company, whether for gas supplied to him in connection with the said fittings or otherwise.

(*b*) If the hirer shall become bankrupt or if a receiving order shall be made against him, or if he shall enter into any composition or arrangement with his creditors.

(*c*) If a distress or execution shall be levied upon any premises where the above fittings shall be used or upon any other premises belonging to the hirer.

11.—In the event of this agreement being determined under any of the foregoing provisions, the hirer shall forthwith deliver up the above-mentioned fittings to the Company, and the Company and its agents and servants shall be entitled to enter upon the premises for the purpose of removing and retaking the same. The determination of this agreement shall not prejudice the right of the Company to recover any sums due at the date of such determination or to become due thereafter.

12.—The hirer shall be responsible for all damage caused to the said fittings, whether by fire or by interference therewith by any person or persons other than the Company's servants or by any other cause whatsoever; and he shall pay to the Company the cost of repairing or replacing any such damage.

As witness, &c.

THE BENEFITS OF GAS COOKING-STOVES.

Dissatisfaction with Electric Cooking.

The Battersea Borough Council have had under consideration an application from their tenants on the Latchmere and Town Hall Estates to be supplied with gas cooking-stoves. The Finance Committee informed the Council at the meeting last Friday, that they were of opinion that the stoves should be installed. If the Council restricted the supply of gas for cooking, and not allow it for lighting, the expense to the Council would be as follows:—Town Hall Estate, Gas Company, £18; Works Department, £7—total £25; Latchmere Estate, Gas Company, £875; Works Department, £80—total £955. Should the Council permit the Gas Companies to light the buildings also, the two items of £18 and £875 would be saved; but the Council's electricity undertaking would lose approximately £35 per annum on the Town Hall Estate and £400 per annum on the Latchmere Estate, because the Companies would not, if permitted to supply light, put a gas-stove in any tenement which did not take light; and, inasmuch as probably each tenant would desire a gas-stove, every tenement would have gas lighting. The Committee recommended that gas-stoves be installed, and that no gas lighting be allowed.

A deputation from the Latchmere Estate, headed by Mr. W. Roger, waited upon the Council, to urge them, without further delay, to agree to the installation of gas-stoves. He maintained that these were a necessity, and were wanted to lighten the burden of the women. The heat from an ordinary fire was very oppressive; and they wished to save coal. Some members were anxious to put in electric stoves; but in many instances they had been removed because the people could not be troubled with them any longer. During the six months he had been a tenant on the Latchmere Estate, he had not had an effective meter; and many times the electric light had failed. Cooking by electricity was too expensive, and would cost more than the tenants could afford. They required something for use, and something reliable. The majority of the tenants were in favour of retaining electric lighting, which, if carefully used, was not much more expensive than gas. The Council had on previous occasions rejected proposals to instal gas-stoves; but he maintained that they were absolute necessities in every home. In previous years, however, the Council had been altogether opposed to the introduction of gas into the tenements. The tenants would not be willing to pay 1s. 6d. a week for the benefit of electric stoves, as against 1s. a week for gas-stoves—in fact, they did not want electric stoves at any price. The majority were in favour of slot-meters.

Mr. W. Willis, the Chairman of the Finance Committee, in moving the adoption of the recommendation, said the difficulty had always been the payments received by the Gas Company for laying the mains in the streets in the event of gas-stoves only being required. Electricity was not the best for cooking, and only one household used it for this purpose in Battersea; but the head of that house was an electrical engineer. The Gas Company's case was that the gas-stove department was the least profitable branch of their business; and they insisted that the Council should contribute to the cost of the mains if the supply was to be for stoves only. The cost of laying the mains would be £875.

Mr. J. Raynor proposed, as an amendment, that the Committee's report be referred back, and that the Electricity Committee should be instructed to fit up one of the houses on the Latchmere Estate with gas and another with electricity, and ascertain the cost of the two systems.

Mr. P. P. Heythornthwaite pointed out that last November the Council issued a printed promise to provide the tenants on the Latchmere Estate with gas for both lighting and cooking purposes.

Mr. J. R. Archer remarked that electrical cooking-stoves had been found to be a dismal failure. A petition in favour of gas-stoves had been signed by 300 out of 315 tenants on the Latchmere Estate.

The amendment was lost, and the Committee's recommendation was carried with three dissentients.

ELECTRIC COOKING AND HEATING.

Under the title "The Truth about Electric Cooking and Heating," the "Standard" newspaper recently published an article written by Mr. W. O. Horsnaill, A.M.I.Mech.E., A.M.I.E.E., some extracts from which will be interesting to readers of the "Journal," in view of the fact that the author controverts what he calls the "bold" statement that electricity at 1d. per unit is actually cheaper than gas at 2s. 6d. per 1000 cubic feet, or coal at market prices. A very simple calculation, he says, will show at once that electricity at its present price must be far more costly than gas; while even the gas authorities themselves admit that they cannot compete with the kitchen range as regards the actual cost of the useful heat produced.

Basis of Comparison.

In order to compare electricity with gas and coal, it is necessary, he continues, to know first of all how much heat can be obtained from a given quantity of each. For instance, a pound of coal contains carbon and other substances which will produce a certain amount of heat if lighted and burnt in a fireplace or stove. Gas is measured in thousands of cubic feet; and similarly a definite quantity of heat can be got from 1000 feet by burning it. One pound of coal contains 14,700 B.Th.U.—that is, enough to raise 14,700 lbs. of water (or 1470 gallons) one degree; or we may raise less water to a higher temperature. Thus 1 lb. of coal would boil nearly 100 lbs. (or 10 gallons) of water from ordinary cold water at 62°. We are assuming for the moment that all the goodness in the coal is used up, and that there are no losses by radiation. Likewise, 1000 cubic feet of gas contain 540,000 B.Th.U., and will boil a proportionately large quantity of water. Electricity cannot exactly be said to *contain* heat; but it can be turned into heat by passing it through wires, as may be seen in the ordinary electric lamp, in which a fine wire is made to glow by the current. Now, if all the heat in one unit of electricity is obtained in this way, we get 3411 B.Th.U., or for 2s. 6d. (at 1d. a unit) 102,330 B.Th.U., against the 540,000 B.Th.U. in 1000 cubic feet of gas costing the same amount. Turning to coal, we find the difference is far greater. We will assume for purposes of comparison that coal costs 25s. a ton, or 1s. 3d. a cwt.—in other words, that 2 cwt. (or 224 lbs.) can be bought for 2s. 6d. These 224 lbs. contain 3,292,800 B.Th.U., against 102,330 and 540,000 for electricity and gas respectively costing a like amount.

Respective Potentialities.

These rather startling figures show us what is possible with electricity, gas, and coal, if all the heat they represent could be utilized. Up to this point also our comparison cannot be disputed by the most bigoted electrical enthusiast. It is only the losses in actual use which allow any scope for differences of opinion as to the relative cost. Comparing the losses in electric ovens and heaters with the wasted heat from gas cookers and stoves, we do not find a great deal of difference. Electrical heating and cooking apparatus is undoubtedly very efficient; not more than 10 per cent. being wasted. Gas is not quite so good; some 25 or 30 per cent. of heat being lost up flues and by radiation. But these losses do not anywhere near counterbalance the big difference in the amount of heat for a given value in money; and electricity still costs at least four times as much as gas for cooking and heating.

Price per Unit.

Instead of 1d. a unit, therefore, electricity must come down to one-quarter of this price, or ¼d. a unit, before it can successfully compete. It is quite possible that in years to come—when electricity is produced at the coal mines on an enormous scale, and is distributed all over the country—we shall be able to buy it at this figure. Even now in some towns electric current is sold at ¼d. a unit for cooking and heating; but

this price certainly entails a loss on the supply authorities who produce it. The electrical advocate will sometimes urge that gas ovens and stoves must be wasteful, because the gas requires a lot of cold air to burn it, and much of the heat produced is used up in heating this air. No one can deny that some air has to be heated for burning both gas and coal, but this loss is represented by the heat in the burnt gases passing up the flue, and it seldom exceeds 10 per cent. of the heat produced.

Upkeep of Equipment.

Apart from the difference in cost between electricity and gas for cooking, there is very little to choose between them—assuming the use of modern gas apparatus with effective flues to carry off the waste gases. But against electricity, we have the high price of the ovens and cookers, and their liability to get out of order. Practically the only trouble with a gas-cooking equipment is the clogging of the burners. But this only occurs after several months' use; and they can be put right at a negligible cost. The repair of electrical apparatus is a very different matter—involving highly skilled work and expensive materials, with consequent heavy charges. As regards boiling water, a gas-ring does the work more quickly at one-third the cost of electricity; and when we come to hot water supplies for baths, &c., the cost of electricity puts it completely "out of court" in competition with gas or coal.

Constant Hot Water Supply.

Neither electricity nor gas can compete with coal for low cost in a household where the kitchen must be continuously heated, and where a constant supply of hot water for baths, &c., is needed. The modern kitchen range, combined with a hot-water boiler, is the cheapest, though by no means the most convenient, arrangement. A coal-fired oven, for instance, is difficult to regulate; and a great many housewives for this reason cook by gas. Then, again, a coal-range makes a lot of dust, and entails a good deal of dirty attendance in the way of lighting fires, cleaning flues, bringing up coals from the cellar, &c., and in a flat or small house where no servant is kept, and where the kitchen need not be warmed—as it is only used when cooking is in progress—gas ovens and rings save a great deal of work. Moreover, the extra cost is trifling under such conditions, as the gas is not used all day. We still, however, want hot water for baths. But this can be provided by geysers, gas-heated storage boilers, or circulators, which heat the water independently of the coal-range.

Objections Removed.

Against the use of gas, we must put occasional obnoxious smells when the apparatus is out of order, and some danger from fumes with bath-geysers. This is, however, only a question of flues and proper ventilators, which can entirely remove these objections. The extra cost of electricity used for the above purposes is by no means trifling, as is soon realized by those who have been persuaded to try it. It is strongly urged by electrical advocates that much less wastage occurs in a joint roasted in an electric oven than when it is cooked by gas or coal; and that the gas fumes give the meat a disagreeable flavour. As regards wastage, there is no reason why electric and coal ovens should differ provided that they are kept at the same temperature. The ordinary gas-oven, with burners inside, is filled with burnt gases, and there is a current of air constantly entering at the bottom, while the gases escape at the top.

Evaporation of Moisture.

Under such conditions, one can easily imagine that the moisture in a joint will be evaporated, and that it will weigh considerably less after cooking. On the other hand, the loss is only water, which has no nourishment in it; and the meat simply becomes more concentrated—any reduction in bulk being made up in quality. In restaurants and hotels, however, this feature is important, as customers expect to get bulk for their money. But it is quite possible to arrange in a gas-oven so that the meat does not come in contact with the gases at all, but is enclosed in a separate container—the conditions being exactly the same as with electric cooking. It is not necessary to construct a special oven, only to enclose the meat in an inner oven.

Heating of Rooms.

Turning to the heating of rooms, we find electricity simply nowhere in the matter of low cost, while gas is much more expensive than coal for all-day heating, unless the number of servants employed can thereby be reduced. The cheapest method of heating a room all day, so far as fuel cost is concerned, is by a slow-combustion anthracite stove; next comes the open coal fire; then the gas-stove; and most expensive of all the electric radiator. To get at the truth of this matter, we must have the results of independent tests, as the figures given by gas companies or electric supply authorities are frequently misleading.

Independent Figures.

Independent figures for open coal-fires, gas-fires, anthracite stoves, and electric radiators, were given by Mr. C. R. Darling in his third Cantor Lecture delivered at the Society of Arts last December. Taking the cost of the open fire as being represented by the figure 1, a gas-fire would cost 1·5, or half as much again, an anthracite stove 0·5, or only half the cost of the open fire, and electric radiators six times as much. These comparative figures are about what one might expect from the heat contained in coal, electricity, and gas, and the losses known to occur in practical use. The open coal-fire was admitted by Mr. Darling to be of an old-fashioned type; and much better results can be obtained from modern designs. But the most pronounced feature is the high cost of heating by electricity.

Saving in Attention.

Electric enthusiasts urge that the saving in attention by having no fires to light, or coal to be brought up from the cellar, together with the absence of dust and dirt, are of sufficient advantage to counterbalance the extra cost. These features are decidedly worth paying for to some extent; but they can be realized at one-quarter the cost by

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From our extensive range we select this week our well-known No. 1214 series—the most successful ever produced. A pioneer series of Slot Cookers which have been brought up to date and which for solid merit are supreme.

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using a gas-fire, while with an anthracite stove burning night and day the cost is only one-twelfth of electricity, and the attention needed almost negligible. Last, but not least, of the features to be set against electricity is the high cost of the apparatus and its liability to get out of order—resulting in expensive repair bills. These drawbacks will, no doubt, be overcome in time; but at present they cannot be ignored by those who have to study economy.

Misleading Figures.

Readers must not be deceived by the figures showing electricity to be cheaper than gas or coal for any ordinary domestic purpose. For instance, the writer was told recently of some electrical cooking apparatus with which a dinner for a small family was prepared for 1½d., whereas in another house, with a gas-oven, the cost was 2½d. for a similar amount of cooked food. Such figures are impossible with gas at 2s. 6d. and electricity at 1d., and where good ovens, &c., are carefully used. If the cost of electricity in this instance was really only 1½d., then it is quite certain that gas could have cooked the dinner for less than ½d. We have already seen that 2s. 6d. worth of electricity (at 1d. per unit) is only capable of producing less than one-fifth the amount of heat contained in 2s. 6d. worth of gas; and we know for certain that at least three-quarters of the heat in the gas is utilized in the gas-oven. Consequently, the cost of electric baking must be four times as much as gas baking; and no "cooked" accounts can possibly alter these figures.

Essential Conditions.

As regards deceptive figures for the heating of rooms, electricity, gas, and coal can only be compared by tests taken in the same room, and under the same weather conditions. The temperature out of doors, for instance, must be the same during each test, and the amount and direction of the wind; while similar openings for ventilation are essential. Even with these precautions, it is not safe to trust to one's feelings; a thermometer must be used to obtain the rise of temperature in all parts of the room. Failing scientific tests of this nature, the only reliable guide is the comfort in a room during a whole winter, and the cost of heating it.

In conclusion, there is no doubt that, for cooking, electricity is quite as convenient as gas; and, in spite of the much higher cost, it is being adopted in place of coal to some extent by those who can afford it. For heating, it is difficult to see any advantage in electricity over gas to justify the extra cost. In the "long run" the price of electricity will probably be reduced to so low a figure as to even compete with coal for heating. But this probability is a long way off yet; and, in the meantime, gas or coal will be used for cooking and heating wherever the cost is of consequence.

The Directors of the European Gas Company, Limited, have decided to recommend the payment of a dividend of 10s. per share, free of income-tax; making, with the interim dividend of this amount paid in February, 20s. a share, or 10 per cent. for the financial year.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Glasgow.—The coke-ovens which have been adopted in the gas-works of the Birmingham Corporation and at other places have evidently impressed Councillor P. G. Stewart, as he is to move, at the next meeting of the Gas Committee, that a Sub-Committee be appointed to obtain information regarding the different types, and to report as to the advisability of installing one or other of these systems in the gas-works of the City.

The districts of Partick and Govan, which have been recently annexed and are now within the boundaries of the city, are desirous of being placed upon the same footing as those within the boundaries prior to annexation as regards the charge for incandescent lighting, including the cost of maintenance, fittings, &c.; and the Watching and Lighting Committee recommend that this charge should be 12s. net.

At the inspection of the water-works connected with Glasgow, opportunity was taken of visiting Balquhidder and inspecting the watershed draining to Loch Voil and Loch Doine. This new catchment area extends to about 24,000 acres, and should give an additional supply to Glasgow of about 40 or 50 million gallons per day. Loch Katrine at present supplies some 67 million gallons, Loch Arklet will add 12 million gallons, and the Gorbals works another 5 millions; so that the total available supply may be said to be 84 million gallons. The population of Glasgow is estimated at 1,132,000, and the daily consumption of water is 72 million gallons, which is increasing each year at the rate of 1½ million gallons per day; so that in eight years the present supply will be all utilized. As far back as 1884, the then Water Engineer, the late Mr. James M. Gale, reported that in 36 years' time the Corporation would have to draw upon the waters of Loch Voil and Loch Doine. To obtain the use of these waters, a tunnel 6 miles long will have to be driven through the hill. It seems that the Loch Arklet scheme is to cost considerably more than was anticipated, owing to the finding of shifting sand where rock had been anticipated, and therefore deeper foundations were required. It is satisfactory to know that the dam is finished, and has proved water-tight. It is hoped that the new works will be inaugurated in the course of two or three months.

Auchterarder.—A special meeting of the Town Council was held on Thursday evening to reconsider the plans put forward by the Gas Company for the erection of a new gasholder. When the plans were last before the Council, the matter was delayed with a view to getting the Gas Company to put the holder a little farther back from the street, where it might be partially hidden by the planting of trees. A letter was submitted from the Gas Company declining to alter the site. A petition was also read from the proprietors and tenants in the vicinity of the site complaining that it would affect the value of the properties in the neighbourhood. It was agreed to continue the application for a

HOT WATER TEXTS. No. 3.

It is the easiest thing possible to cause a good boiler to show a low efficiency, or even to be a complete failure, by quite small errors in the pipe connections. We advise free—and freely—and efficiency may be relied on if our advice is followed.

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For the maximum of efficiency in supplying Hot Water for all domestic purposes it is essential that the boiler be WRIGHT'S CALEFACTOR.

JOHN WRIGHT & CO.,
Essex Works,
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week, and to send the Company a copy of the petition, in the hope that the Directors would yet see their way to place the holder in such a position as would not adversely affect anyone.

Carluke.—The annual general meeting of the Carluke Gas Company, Limited, was held on Friday. The Directors' report for the year ending April 30 was submitted, and showed the income for the year to amount to £3761, and the expenditure to £2974; leaving a profit for the year of £787. A dividend of 2s. per share, with a bonus of 6d. per share, was recommended and agreed to. This absorbs a sum of £625; and the balance of £161 14s. 7d. is being carried forward.

Denny.—The Town Council of Denny and Dunipace, who are the proprietors of the gas-works, find themselves in a very happy position, in that they have been able to resolve to reduce the price of gas by 5d. per 1000 cubic feet. This brings the price down to 3s. 4d.

Falkirk.—A special meeting of the Town Council was held to deal with the condition of affairs at the gas-works, when the report of the Sub-Committee was brought forward. In regard to the retort-bench, the Sub-Committee remark: "Being satisfied that the retort-bench is gradually sinking, and that some steps must be taken immediately to remedy this defect, they had borings made of the subsoil, the journal of which bores was contained in the Gas Manager's report of April 11. The Sub-Committee had also had three trial pits sunk to ascertain the nature of the subsoil, a report as to the load-standing capacity of which was submitted by the Gas Manager on May 6. The Sub-Committee recommended that the retort-bench be underpinned at an estimated expense by Mr. M'Kee and the Gas Manager of £1378, as contained in the Gas Manager's report of May 19. It was agreed that the work of underpinning be carried out by Mr. Thomas M'Kee in conjunction with the Gas Manager, and it was remitted to the Sub-Committee with powers to see the work executed." A long and heated discussion ensued, some of the speakers again favouring the appointment of an expert to advise on the question of the foundations of the retort-bench. The majority, however, decided upon having the work recommended by the Committee carried out; and this was the ultimate finding of the meeting by 8 votes to 5.

Motherwell.—The Gas Company have declared a dividend of 13¼ per cent. for the year. The works are shortly to be taken over by the Town Council, as soon as the price can be adjusted.

Pitlochry.—The annual meeting of the Gas Company was held on Thursday. The accounts showed a considerable improvement on those of the previous year; but the increased profit was mainly due to the enhanced price of residuals and coke. Coal being estimated to cost 1s. per ton more than last year, the price of gas will remain as before. The balance-sheet showed a credit of £567. It was agreed to wipe £250 off the gas establishment, and to declare a dividend of 5 per cent.

Prestwick.—A special meeting of the Town Council of Ayr have approved of the inclusion of the burgh of Prestwick and district of Alloway in the electric lighting area. The conditions include the power to the Prestwick Town Council to acquire the undertaking, so far as it extends within the Prestwick boundary, after thirty years.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 28.

Sulphate of Ammonia.

There has been a steady demand all through the week, but it has not been sufficient to bring about a recovery in values. Requirements have again been mainly for the purpose of covering contracts for June shipment, direct orders having been rather scarce. The closing prices are £12 16s. 3d. per ton f.o.b. Hull, £12 17s. 6d. to £12 18s. 9d. per ton f.o.b. Liverpool, and £13 per ton f.o.b. Leith. There has been a fair amount of business doing for delivery over the near months at a premium of 2s. 6d. to 5s. per ton on spot prices; but for delivery over next spring months, the firmness of makers has almost precluded business in that position.

Nitrate of Soda.

The market is quiet but steady; quotations being 10s. 7½d. per cwt. for ordinary, and 10s. 9d. for refined quality.

LONDON, *June* 30.

Tar Products.

The markets for tar products continue quiet, and there is little or no business doing in the majority of articles. In pitch, some further selling has been done for prompt delivery, and, in fact, to the end of the year, at slightly lower prices. In one or two instances, further sales would have been made; but the difficulty has been the question of shipment for prompt delivery. However, the only thing which will make consumers purchase at the moment is a further reduction in price. Ninety per cent. benzol remains firm; and there is no alteration in the quotation. Solvent naphtha continues quiet; but one or two sales have been reported for the forward position. Crude carbolic is exciting very little interest indeed just now. Consumers are unwilling to pay the present prices; but, on the other hand, distillers are not inclined to take the present value for the forward position. Creosote keeps fairly firm, but there is no alteration in price.

The average values during the week were: Tar, 25s. 3d. to 29s. 3d. Pitch, London, 41s. to 42s.; east coast, 40s. 6d. to 41s. 6d.; west coast, Manchester, 40s. to 41s.; Liverpool, 41s. to 42s.; Clyde, 41s. to 42s. Benzol, 90 per cent., naked, London, 1s. 0½d. to 1s. 1d.; North, 1s. to 1s. 0½d.; 50-90 per cent., naked, London, 10d. to 10½d.; North, 10d. Toluol, naked, London, 11d. to 11½d.; North, 10⅞d. to 11d. Crude naphtha, in bulk, London, 5½d. to 5⅝d.; North, 4⅝d. to 5¼d. Solvent naphtha, naked, London, 11d. to 11½d.; North, 9d. to 9½d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10d. to 10½d. f.o.b. Creosote, in bulk, London, 3½d. to 3¾d.; North, 2⅝d. to 3d. Heavy oils, in bulk, 3¼d. to 3⅝d. Carbolic acid, casks

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included, 60 per cent., prompt, east and west coasts, 1s. 3d. to 1s. 3½d. Naphthalene, £5 to £9; salts, 50s. to 55s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

Sulphate of Ammonia.

A very quiet week has again been experienced in this article, and little fresh business has been done. In some quarters, endeavours have been made to stop the decline; and with this idea some fair prices have been offered for the forward position. Outside London makes are quoted at £12 5s.; Hull, £12 16s. 3d.; Liverpool, £12 17s. 6d.; Leith, £12 18s. 9d. to £13; Middlesbrough, £12 16s. 3d. to £12 17s. 6d.

COAL TRADE REPORTS.

Northern Coal Trade.

There is now a fuller demand for coal, and arrivals of steamships are heavier, so that better shipments are following. In steam coal, prices are firmer; and the quotations may now be put at, for best Northumbrians, from 14s. 10½d. to 15s. per ton f.o.b. Second-class steams are about 13s. 3d. per ton; and steam smalls are steadier at 8s. 3d. to 10s. per ton f.o.b. Production is now fuller, though some local strikes prevent it being quite normal. In the gas coal trade, the deliveries seem slightly better—the lower steamer freights inducing shipments to add to stock. For best Durham gas coals, the quotation is now about 14s 9d. to 14s. 10½d. per ton f.o b., and second-class gas coals are near 13s. 6d. "Wear specials" are about 15s. 3d. to 15s. 9d. per ton f.o.b., and appear to be fairly well sold. Many of the contracts that have been booked in the last few weeks are this week commencing deliveries. In coke, the market is quiet. Gas coke is less plentiful, and is quoted from 18s. to 18s. 6d. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

There has been a much modified demand for all kinds of coal during the past week; and on Friday, on the Glasgow Coal Exchange, the following were the approximate prices quoted: Steam coal, 12s. 3d. to 12s. 9d.; splint, 13s. 6d. to 14s.; ell, 12s. 3d. to 12s. 9d.; trebles and doubles, 12s. 6d. to 13s.; singles, 12s. to 12s. 3d. f.o b. Glasgow.

We are asked to intimate that Messrs. Willey and Co., Limited, have built new meter-works at Hertford Road, Kingsland, N., and, as from the 25th ult., have removed their offices from Adam Street, Adelphi, to the above address.

The Bonnyrigg (N.B.) Town Council have decided to instal all their gas-lamps with the "A & M." patent automatic lighting and extinguishing apparatus, and, where necessary, the "Alder and Mackay" hurricane-proof lantern. This installation will require to be operated from the gas-works situated in Lasswade.

Wanganui (N.Z.) Corporation Gas Undertaking.

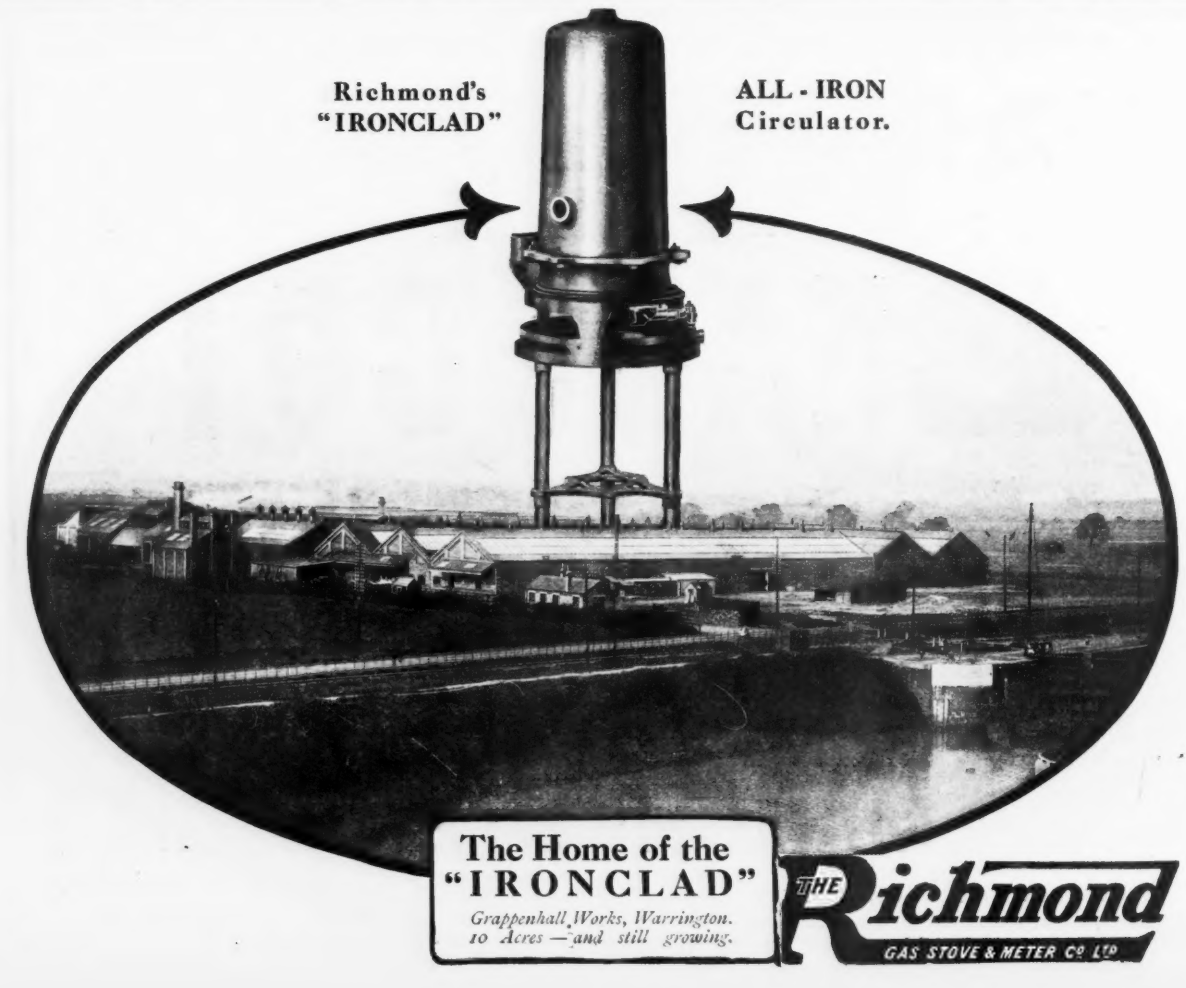
The report of Mr. G. D. Stone, the Engineer and Manager of the gas undertaking of the Wanganui Corporation, for the year ended the 31st of March last discloses a very satisfactory state of affairs. The increase in the output of gas was 14,315,000 cubic feet, equal to about 17⅛ per cent.; and additional revenue derived from sales of gas, coke, and tar totalled £3475. The extra quantity of coal carbonized was about 463 tons; and the average make of gas per ton was a large increase on any previous year, amounting to 14,520 cubic feet, which is stated to be a record for the Dominion. The profits made were exceptionally large, totalling £11,228. They have all been absorbed in the manner detailed in the report; and a debt of £1150 is left on the general account.

Tipton Gas Undertaking.

The report on the working of the gas undertaking of the Tipton Urban District Council in the past financial year, by the Engineer and Manager (Mr. Sidney O. Stephenson), is of a very encouraging nature. The consumption of gas showed the large increase of 7 million cubic feet; and the profit was by far the greatest made by the undertaking. The record net profit previously was that realized in 1908, when it was £2541. Since then reductions have been made in the price of gas all round, varying from 3d. to 11d. per 1000 cubic feet. The financial position of the concern is good; and, with the completion of the extensions, Tipton will soon have up-to-date and well-equipped gas-works. In Mr. Stephenson's opinion, the prospects of the Gas Department are very bright indeed.

Compensation to a Gas Workman's Widow.—At the Paignton County Court on Monday last week, Mr. Ernest Hutchings made an application, under the Workmen's Compensation Act, with reference to the payment of £300 to the widow of a man named Stevens, a foreman in the employ of the Torquay Gas Company, who was killed in April last. The widow, who was 73 years of age and unable to work, had no one dependent upon her. An application was made for the payment of £1 per week from the date of her husband's death. The widow gave evidence, and his Honour granted the application.

Obtaining Gas by Fraud.—A labourer named John Sadler, of Wakefield, has been ordered to pay £2 9s., or undergo a month's imprisonment, for obtaining gas by means of fraud. It appeared that his meter was taken away in December, 1907, and the tap from the main was securely fastened. On the 4th ult., a gas inspector visited the house, and found a piece of flexible tube attached from the inlet to the fittings in the house. The tube was very rusty, and apparently had been used for a considerable time. In the kitchen, there was a gas-jet burning, on which a kettle was boiling. The Chairman of the Bench described the offence as a very serious one, and said defendant had rendered himself liable to a penalty of £5 and £1 per day.



Leeds Water-Works Inspection.

On the annual visit, last week, of the members of the Leeds Corporation to the Leighton reservoir and the Colsterdale Valley, they were accompanied by the Chairman of the Water Committee (Alderman Arthur Willey), the Deputy-Chairman (Alderman Robert Pickersgill), and the Water Engineer (Mr. C. G. Henzell). After viewing the progress of the works, which still need time for completion, the party dined in a marquee, after which, Alderman C. H. Wilson, proposing "Success to the Water Committee," said the citizens had every reason to be satisfied with the great pains the Committee had taken to secure a pure supply of water which would be adequate for their needs. In the course of his reply, Alderman Willey remarked that some people thought the Leeds Corporation were a little precipitate in commencing the Leighton reservoir; and though at first he was disposed to agree with them, his view had been changed by the fact that the demand for water was increasing, and that the new supply would not be available for three or four years. They must in these matters look well ahead; and they had to thank those who had preceded them for providing them with such magnificent areas from which to draw their water. They had on the site some 577 acres, which had cost £71,000—an average of about £123 an acre; and, in the circumstances, it was an exceptionally good and favourable purchase. The claim amounted to something like £194,000, and the result of the arbitration was between £40,000 and £50,000. On the Laver estate they had 2000 acres, for which they gave £106,000; and here eventually they might have to construct several reservoirs. The present work was colossal; but they had looked to every eventuality, and taken every precaution that engineering skill and foresight could devise—spending a large sum on extra work to guard against any possible error in construction. Those who complained of the extra water charges should go there and see what was involved in giving a proper supply, and remember that, while Leeds had not reached the maximum charge, some other towns were not only at the maximum, but levied a rate-in-aid.

New Water-Works in Ontario.—Some improvements to be carried out to the water supply system at Fort William, Ontario, involve the construction of tunnels under the Kaministiquia, the Mission, and the M'Kellar Rivers. These tunnels will measure 7 ft. by 8 ft., 5 ft. by 6 ft., and 5 ft. by 6 ft. in section, and 1285 feet, 685 feet, and 637 feet in length. There will be two 10-feet and four 8-feet reinforced concrete shafts; and 1306 feet of two-ring and 1275 feet of three-ring brickwork.

Sydney Gas Strikers Heavily Fined.—It was recently mentioned in the "JOURNAL" that between 200 and 300 summonses had been issued against the gas workers who struck in Sydney early in the year. According to a Reuter telegram, Mr. Justice Heydon, the Judge of the New South Wales Court of Industrial Arbitration, last Tuesday fined one of the men £10, and 99 others £8 each, with a guinea costs in every case—all chargeable against their wages—declaring that the gas strikers were the ringleaders in the recent industrial troubles.

Stourbridge Gas Department.

The Gas Engineer and Manager of the Stourbridge Urban District Council (Mr. Charles H. Webb) has presented his report for the year ended the 31st of March. There was an increase of 8,433,500 cubic feet in the quantity of gas sold, compared with the preceding twelve months, notwithstanding the greatly reduced output in April, 1912, due to the coal strike. The result of the year's trading was a gross profit of £11,714; and after deduction of income-tax, annual instalments, and interest, the surplus was £2900—an increase of £445. At the close of his report, Mr. Webb gives some figures to show the progress made by the gas undertaking since it was acquired by the Council at the close of 1892. In the year ended Dec. 31, 1892, there were 81,879,400 cubic feet of gas sold, of the value of £11,069; and the total income was £15,396. On March 31, 1903, the figures stood thus: Gas sold, 166,050,600 cubic feet; value, £23,061; income, £30,806. At the close of the past financial year they were: Gas sold, 215,394,100 cubic feet; value, £28,760, at lower prices; income, £42,420.

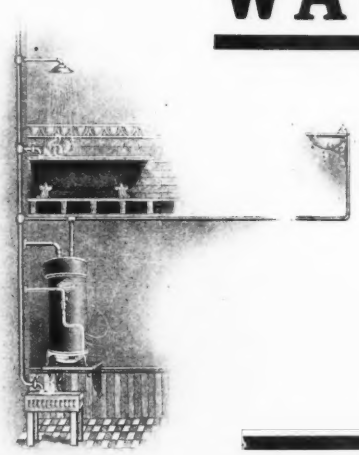
Electricity Finance at Ipswich.

Some enlightening figures were quoted by a member of the Ipswich Town Council, when the Electricity and Tramways Committee recommended (and it was agreed) that borrowing powers should be obtained for a round sum of money for carrying out an extension scheme. Mr. Rowley Elliston said he had been expecting to hear something of the financial side of the scheme; and he confessed, though the scheme was a good one, he was getting a little nervous of the growth of capital expenditure on the electric light undertaking. That day in the Council he had heard no criticism of the increased financial outlay, though they were told they had reached the limit of capital expenditure; and the electric undertaking in particular was over-capitalized. Within the last twelve months, they had sanctioned some £44,500 for this undertaking, and last year they sanctioned £11,000 capital expenditure; and unfortunately the revenue showed a deficiency of £1707. Now they were asking for £33,500; and on the whole capital they would be involved in interest charges of about £1780, and £2000 repayment of capital—roughly, £4000 a year, which meant a 3d. rate, unless they could be sure the undertaking was to show an increase in revenue. When a scheme was to come before the Council for borrowing capital, it should be placed before them when they were framing the estimates, so that they could see where they were. He did not oppose the scheme, but wished to point out to the Council the growth of capital expenditure, and to say that these matters should be brought before them at the beginning of the year, instead of leaving them to come in and be approved of haphazard.

Burners, Limited, has been registered with a capital of £2000, in £1 shares, to carry on the business of manufacturers of gas burners and fittings, &c.

PARKINSON

WATER HEATERS.



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Gas Automatically Regulated.

For full particulars see Hot Water Catalogue No. 100.

The PARKINSON STOVE CO., Ltd.

(Incorporating Maughan's Patent Geyser Co.),

BIRMINGHAM & LONDON.

Natural Gas and Oil in the South of England.

The annual meeting of the South of England Natural Gas and Petroleum Company, Limited, was held last Friday, under the presidency of Mr. E. E. Rouse. In moving the adoption of the report, the Chairman said the position of the Company at the present time was favourable to the shareholders; but money was required to carry on the business. Some suggestions had been made for modifying the original programme, which had been to bore for oil; and in view of the developments which had been taking place in other countries, especially in America, where gas had been put to commercial use for the manufacture of spirit, the Directors had under consideration a plant for this purpose. They had a definite programme in front of them, involving a comparatively small expenditure for the utilization of their properties and concessions in Sussex in this manner, turning them into a going concern. This was considered a better plan than going down 2000 or 3000 feet with the sole object of obtaining oil. In view of expert opinion, there could not be the slightest doubt that oil existed in the substrata; but the first object of the Company must be to earn a dividend, however small, and with this in view the Directors had come to the conclusion that they should first endeavour to utilize the gas, which could be obtained with a comparatively small expenditure. While this was going on, they could continue boring for oil.

At Warwick Bankruptcy Court, a few days ago, before his Honour Judge Sir Thomas Snagge, K.C.M.G., an application was made by Mr. C. E. R. Terry, gas engineer, of St. Winifred's, Leamington, for his immediate discharge from bankruptcy. Mr. Crowther Davies, who appeared for him, said the bankrupt had discharged all his private debts. The Official Receiver left the matter in his Honour's hands; and he made an order for discharge in two years and one month from the date of the receiving order—June 2, 1911.

APPLICATIONS FOR LETTERS PATENT.

13,851.—Kennedy, R., "Water-meters." June 16.
13,874.—Culley, A. E., "Detecting presence of gases." June 16.
13,909.—Jennings, G. L., "Boiler for gas cooking-stoves." June 16.
13,924.—Anderson, J., and Hippius, J., "Fuel." June 16.
13,929.—Poole, R. M., "Manufacturing wood gas." June 16.
13,985.—Oliver, C. R., and Auto Lighter, Ltd, "Ignition device." June 17.
14,046.—Geb. Keller Baugeschäft Akt.-Ges., "Continuous distillation of tar." June 17.
14,055.—Sutcliffe, E. R., "Fuel." June 18.
14,156.—Meade, T., "Recording the flow of liquids." June 19.
14,193.—Holloway, J., "Gas-compressors." June 19.
14,219.—Price, T. E., and Turner, H. O., "Nipple-regulators for atmospheric burners." June 19.
14,230.—Raschig, F., "Continuous distillation." June 19.
14,275.—Stubbs, S. H., "Cocks." June 20.
14,282.—Biheller, S., "Gas-lamps." June 20.
14,322.—Rooke, T., "Gas-meter counting apparatus." June 20.
14,343.—Parkinson and W. & B. Cowan, Ltd., and Scott, T., "Dry meters." June 20.
14,367.—Thorp, F. & H. T., "Gas-lamps." June 21.
14,379.—Hughes, H. S., "Water-meters." June 21.
14,385.—Pendleton, A., "Gas economizer." June 21.
14,420.—Jaubert, G. F., "Purifying and cooling hot gases." June 21.
14,425.—International Air Gas Corporation, Ltd., and Donnithorne, H. E. A. C., "Air-gas plant." June 21.

The East Surrey Water Company notify that they are about to sell by tender 700 ordinary shares of £10 each.

GAS COMPANIES' STOCK AND SHARE LIST.

It is gratifying to be able to note a marked improvement last week in the general tone of things on the Stock Exchange, though markets have not jumped up all at once. It is better that it should be so; for a slow and sure recovery is more healthy in the long run than a sharp boom, which may easily be overdone. It was account week; and, though perhaps not wholly without the need of assistance here and there, the settlement appears fairly well completed. The money position was less stringent; and, but for the state of affairs between the Balkan Allies, the week would have been quite cheerful. The opening on Monday, however, was far from promising. Not only was there the apprehension regarding the Eastern situation, but other factors were unpropitious, and markets were despondent. But later some recovery restored the balance. Government issues closed stronger, Consols rising ⅛. Rails also scored some advances. The Foreign and American Markets were not at their best. Tuesday was a much better day; and the improvement was almost general—mainly through things looking lighter in the East. Consols gained another ⅛, Rails were strong with higher prices, and the rest moved in sympathy. Wednesday began fairly, but became sensitive and swayed irregularly. But things were pretty steady at the close, except in Government issues, where Consols fell ⅛. Rails gained on the whole. Thursday opened with less confidence. Balkan advices caused apprehension; but calmer views supervened, and the close was firmer for the most part. This disposition was maintained on Friday; and markets in general (excepting the American) were fairly cheerful, though business was at low pressure. Government issues showed strength, and Consols were higher; Rails were in good case with rising prices; and the Foreign Market was firmer. Saturday was a very quiet day; but the tone was moderately good, though the Balkan outlook might have been more encouraging. Markets in general were steady. Consols closed at 73 to 73⅛—a rise of ⅜ in the week. In the Money Market, there was a good demand for the half-year's end and other purposes. Discount rates showed less stringency. Business in the Gas Market was only moderate in volume, and—as has not infrequently occurred recently, was restricted to a few undertakings, not a dozen being touched at all. Changes in quotation, except those attributable to *ex div.* adjustment, were few and slight. In Gaslight and Coke issues, the ordinary was not very active, and prices realized ranged from 99¾ to 101½—a fall of ½. In the secured issues, the maximum changed hands at 77 and 78½, the preference at 96 (a rise of ½), and the debenture at 73⅜. South Metropolitan was steady and unchanged at 108⅛ to 109⅜; and the debenture marked 73½. Nothing was done in Commercials. Among the Suburban and Provincial group, British realized 45½ and 45⅜, Bournemouth "B" 15⅛, South Suburban 117 to 117¾, and Tottenham "B" 116¾. In the Continental companies, Imperial was done at 162½ to 166 (a rise of 1), and European at 17⅞ to 18. Among the undertakings of the remoter world, Oriental marked 126, Primitiva 5 13/16 to 6, ditto preference 4⅞ to 5, and ditto debenture 93½ and 94.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	April 11	5	Alliance & Dublin Ord.	70–73	..	6 17 0
374,000	,,	Jan. 16	4	Do. 4 p.c. Deb.	84–87	..	4 12 0
280,000	5	April 11	7½	Bombay, Ltd.	6¼–6⅝	..	5 11 1
50,000	10	Feb. 27	15	Bourne- mouth Gas and Water } 10 p.c. B 7 p.c. Pref. 6 p.c.	28⅜–29½	..	5 1 8
332,000	10	,,	7		15½–16	..	4 7 6
75,000	10	,,	6		13⅜–14½	..	4 4 3
880,000	Stk.	Feb. 27	14	Brentford Consolidated	260–265	..	5 5 8
330,000	,,	,,	11	Do. New	200–205	..	5 7 4
50,000	,,	,,	5	Do. 5 p.c. Pref.	113–115	..	4 6 11
206,250	,,	June 13	4	Do. 4 p.c. Deb.	92–94	..	4 5 1
217,380	Stk.	Feb. 27	11	Brighton & Hove Orig.	206–211	..	5 4 3
244,200	,,	,,	8	Do. A Ord. Stk.	151–154	..	5 3 11
530,000	20	Mar. 28	12½	British	45–46	..	5 8 8
120,000	Stk.	June 27	4	Do. 4 p.c. Deb. Stk.	87–89*	..	4 9 11
245,771	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	83½–91½*	..	4 7 5
100,000	10	—	—	Cape Town & Dis., Ltd.	2–3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4–5	..	—
100,000	Stk.	June 27	4½	Do. 4½ p.c. Deb. Stk.	75–80*	−¾	5 12 6
157,150	Stk.	Feb. 13	5	Chester 5 p.c. Ord.	109½–111½	..	4 9 8
1,513,280	Stk.	Feb. 27	5/9/4	Commercial 4 p.c. Stk.	105–107	..	5 2 1
560,000	,,	,,	5½	Do. 3½ p.c. do.	102–104	..	5 2 6
475,000	,,	June 13	3	Do. 3 p.c. Deb. Stk.	69–71	..	4 4 6
800,000	Stk.	,,	4	Continental Union, Ltd.	80–83	..	4 16 5
200,000	,,	,,	7	Do. 7 p.c. Pref.	124–126	−2½	5 11 1
492,270	Stk.	—	5¾	Derby Con. Stk.	124–125	..	4 12 0
55,000	,,	—	4	Do. Deb. Stk.	103–105	..	3 16 2
1,002,180	10	Jan. 16	10	European, Ltd.	17½–18½	..	5 8 1
16,415,840	Stk.	Feb. 13	4/17/4	Gas-light and Coke } 4 p.c. Ord. 3½ p.c. max. 4 p.c. Con. Pref. 3 p.c. Con. Deb.	99½–101½	−¼	4 15 10
2,600,000	,,	,,	3½		77–80	..	4 7 6
4,062,235	,,	,,	4		94–97	+½	4 2 6
4,674,850	,,	June 13	3		71½–73½	..	4 1 8
258,740	Stk.	Mar. 13	5	Hastings & St. L. 3½ p.c.	89–91	..	5 9 11
82,500	,,	,,	6½	Do. do. 5 p.c.	—	..	—
70,000	10	April 25	11	Hongkong & China, Ltd.	17–17½	..	6 5 9
131,000	Stk.	Mar. 13	7⅜	Ilford A and C	152–155	..	4 18 4
65,780	,,	,,	6½	Do. B	120–122	..	5 0 5
65,500	,,	June 27	4	Do. 4 p.c. Deb.	87–89*	..	4 9 11
4,940,000	Stk.	May 16	9	Imperial Continental	161–166	+1	5 8 5
1,235,000	Stk.	Feb. 13	3½	Do. 3½ p.c. Deb. Red.	85–87	..	4 0 6
200,242	Stk.	Mar. 13	6	Lea Bridge Ord. 5 p.c.	120–123	..	4 17 7
561,000	Stk.	Feb. 27	10	Liverpool United A	208⅜–210½	..	4 15 0
718,100	,,	,,	7	Do. B	150–152	..	4 12 1
306,083	,,	June 27	4	Do. Deb. Stk.	96–98*	..	4 1 8
63,480	Stk.	June 27	3	Maidstone 3 p.c. Deb.	66½–68½*	..	4 7 7
75,000	5	June 13	6	Malta & Mediterranean	4⅞–4¾	..	6 3 1
250,000	100	April 1	4½	Met. of Melbourne } 4½ p.c. Deb.	98–100	..	4 10 0
541,920	20	May 30	4	Monte Video, Ltd.	12½–13	..	6 3 1
1,775,892	Stk.	Feb. 27	4½	Newc'tle&G'tesh'd Con.	98½–99½	..	4 10 6
529,705	Stk.	June 27	3½	Do. 3½ p.c. Deb.	83½–84¼*	..	4 3 1
55,940	10	Feb. 27	7/7/0	North Middlesex 7 p.c.	13–14	..	5 4 7
300,000	Stk.	May 16	8	Oriental, Ltd.	124–129	..	6 4 0
60,000	5	Mar. 28	10	Ottoman, Ltd.	8–8½	..	5 17 8
60,000	50	Feb. 27	13	Portsea, Island B	125–128	..	5 1 7
100,000	50	,,	12	Do. C	122–125	..	4 16 0
249,980	5	May 16	8	Primitiva Ord.	5⅞–6¼	..	6 8 0
499,960	5	June 27	5	,, 5 p.c. Pref.	4 11/16–4 13/16*	..	5 1 2
521,600	100	June 2	4	,, 4 p.c. Deb.	93–95	..	4 4 3
346,198	Stk.	June 27	4	River Plate 4 p.c. Deb.	90–92*	..	4 7 0
275,000	5	Apl. 11	12	San Paulo, Ltd.	—	..	—
150,000	10	,,	6	Do. 6 p.c. Pref.	11½–11⅞	..	5 2 2
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.	49–51	..	4 18 0
135,000	Stk.	Mar. 13	10	Sheffield A	225–227	..	4 8 1
209,984	,,	,,	10	Do. B	225–227	..	4 8 1
523,500	,,	,,	10	Do. C	225–227	..	4 8 1
90,000	10	May 30	7½	South African	9½–10½	..	7 2 10
6,429,895	Stk.	Feb. 13	5/9/4	South Met., 4 p.c. Ord.	108–110	..	4 19 4
1,895,445	,,	Jan. 16	9	Do. 3 p.c. Deb.	73–75	..	4 0 0
209,820	Stk.	Feb. 27	8½	South Shields Con. Stk.	161–163	..	5 4 4
952,795	Stk.	Feb. 27	6	S'th Suburb'n Ord. 5 p.c.	117–119	..	5 0 10
60,000	,,	,,	5	Do. 5 p.c. Pref.	115–117	..	4 5 6
117,058	,,	June 27	5	Do. 5 p.c. Deb. Stk.	115–117*	+½	4 5 6
594,740	Stk.	May 16	5	Southampton Ord.	102–105	+1	4 15 3
120,000	Stk.	Feb. 13	7½	Tottenham A 5 p.c.	139–142	..	5 2 1
483,940	,,	,,	5¼	and B 3½ p.c.	115–117	..	4 18 3
149,470	,,	June 27	4	Edmonton 4 p.c. Deb.	90–92*	..	4 7 0
182,380	10	,,	5	Tuscan, Ltd.	5–6	..	8 6 8
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	96½–98½	..	5 1 6
236,476	Stk.	Feb. 27	5	Tynemouth, 5 p.c. max.	114–115	..	4 6 11
				Wandsworth, Wimbledon, and Epsom—			
30,000	Stk.	..	..	Wandsworth A 5 p.c.	160–165	..	—
255,636	,,	..	..	,, B 3½ p.c.	132–137	..	—
108,075	,,	..	..	,, C 3½ p.c.	113–118	..	—
352,000	,,	..	..	Wimbledon 5 p.c.	110–115	..	—
98,000	,,	..	..	Epsom 5 p.c.	117–122	..	—
88,416	,,	June 27	3	3 p.c. Deb. Stk.	66½–68½*	..	4 7 7

Prices marked * are "Ex-Div."

Sale of Stocks and Shares.

Acting under instructions from executors, Messrs. A. & W. Richards offered for sale, at the Mart, Tokenhouse Yard, E.C., last Tuesday, stocks and shares in several gas companies. The first lots consisted of ordinary "B" stock of the Ilford Gas Company, ranking for a standard dividend of 3½ per cent., subject to the sliding-scale; the dividend for the year ended Dec. 31 last having been at the rate of £6 2s. 6d. per cent. The stock fetched £120 to £123 per £100. Some 5 per cent. "C" stock of the Company (last dividend £7 12s. 6d. per cent.) sold for £152 to £155. Original ordinary consolidated 10 per cent. stock of the Brighton and Hove Gas Company, on which the last dividend was at the rate of 11 per cent., realized from £206 to £208 per £100. Nearly £3000 of the Company's "A" consolidated stock (ranking for 7 per cent., but carrying 8 per cent.) fetched £151 to £153 10s. per cent. Some "B" consolidated 3½ per cent. stock of the Tottenham and Edmonton Gas Company, entitled, at the present price of gas, to a dividend at the rate of £5 17s. 6d. per cent. per annum, was sold at £115 to £116 5s. per £100. A small quantity of ordinary 5 per cent. stock of the South Suburban Gas Company (last dividend at the rate of 6 per cent.) realized £118 per cent. A few £10 additional 7 per cent. shares in the North Middlesex Gas Company, carrying £7 7s. per cent., were sold at £14 10s. to £15 each. About £3000 of consolidated stock of the Brentford Gas Company, the last dividend on which was at the rate of 14 per cent., realized from £262 10s. to £266 per £100; some new (7 per cent.) stock., carrying 11 per cent., being sold at from £208 to £209. A few £20 shares in the British Gaslight Company, Limited, the last distribution on which was equivalent to 12½ per cent. per annum, realized from £45 to £46 5s. apiece. Fully-paid £10 shares in the European Gas Company, Limited (last dividend 10 per cent., free of income-tax) fetched £17 12s. 6d. to £17 15s. each. Some £10 shares in the South African Lighting Association, on which the dividend for last year was at the rate of 9 per cent., less tax, were sold for £10 10s., to £10 15s. each. In most cases the purchasers take the half-year's dividends accruing from the 1st of January.

Award in the Chatsworth Arbitration.—In the "JOURNAL" for the 3rd ult. (p. 683), the proceedings were reported in an arbitration to determine the amount to be paid to the Duke of Devonshire by the Derwent Valley Water Board in respect of easements for water-mains through the Chatsworth Estate, for which a claim was made for about £43,000. The Board considered that £6000 would meet the case; but it was suggested by Sir A. Cripps, K.C., who appeared for them, that the Arbitrators would not have to consider a difference between £43,000 and £6000, but between the latter sum and £15,000 or £16,000. The Arbitrators were Mr. John Farrer, for the Duke, and Mr. John German, for the Board; and the Umpire was Mr. C. A. Russell, K.C., who has awarded £14,920.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

CHIEF ASSISTANT. No. 5756. Applications by July 9.
ENGINEER (Factory). No. 5755.
METER REPAIR MAN. Ottawa Gas Company, Canada.
REPRESENTATIVE (Lighting). No. 5754.
STOKER. Shaftesbury Gas-Works.

Appointments, &c., Wanted.

CHEMICAL PLUMBER. Davies, Galloway Road, Shepherd's Bush, W.

Gas-Works Wanted.

D. GORDON, 31, New Bond Street, W.

Plant (Second Hand) Wanted.

AMMONIA STILL. No. 5757.

Patent Licences.

TREATING COAL FOR COKING PURPOSES. Haseltine, Lake, and Co., 28, Southampton Buildings, W.C.

Loan Wanted by Gas Company. No. 5751.

Sales of Stocks and Shares.

DANISH GAS COMPANY. London Mart. July 8.
EAST SURREY WATER COMPANY. By Tender. July 25.
GASLIGHT AND COKE COMPANY. London Mart. July 8.
HOUGHTON-LE-SPRING GAS COMPANY. London Mart. July 8.
SOUTHAMPTON GASLIGHT COMPANY. By Tender. July 21.
SOUTHEND WATER COMPANY. London Mart. July 8.
SOUTHGATE GAS COMPANY. London Mart. July 8.

TENDERS FOR

Coal.

BLANDFORD GAS COMPANY. Tenders by July 7.
BRADFORD GAS DEPARTMENT. Tenders by July 17.
DEVON GAS ASSOCIATION. Tenders by July 5.
SWINTON AND MEXBOROUGH GAS BOARD. Tenders by July 16.

Exhauster and Engine.

CUDWORTH URBAN DISTRICT COUNCIL. Tenders by July 7.

Gasholders (Dismantling and Removing).

HUDDERSFIELD GAS DEPARTMENT. Tenders by July 5.

Oil for Gas Making.

LEEDS GAS UNDERTAKING. Tenders by July 19.

Pipes.

ST. MARY CHURCH GAS-WORKS. Tenders by July 17.

Sulphuric Acid.

BLANDFORD GAS COMPANY. Tenders by July 7.

Tar.

BLANDFORD GAS COMPANY. Tenders by July 7.

A Handsome Foolscap Volume giving a complete account of the

GRANTON GAS-WORKS

OF THE

EDINBURGH AND LEITH CORPORATIONS' GAS COMMISSIONERS

Their

Design, Construction, and Equipment,

WITH ILLUSTRATIONS, PLATES, AND DETAILS OF COSTS,

By W. R. HERRING, M.Inst.C.E., &c.

The volume consists of 300 pages, embellished with 228 Photographic and other Illustrations, and 28 large folding Plates. In addition, the Appendices give (in full) the Specifications and detailed Schedule of Quantities of the Brick and Puddle Gasholder Tank and of the Four-Lift Telescopic Holder at Granton.

Bound in Cloth, price 16s. net cash, free delivery in the United Kingdom.

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No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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